Università di Pisa

Department of Computer Science
Master degree in Business Informatics

Improving the sales forecast process: lifecycle of a BI application in Piaggio

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Academic Year 2014-15

Contents

Introduction

This thesis shows a work produced in the period from June 2015 to January 2016 in Piaggio Group company, having corporate headquarters located in Pontedera. Since 1946, Piaggio is the European leader in automotive two-wheeler sector and light commercial vehicles. The big growth started after the conceiving of Vespa, that represents a big turning for Piaggio, nonetheless for the transportation of the country. The global financial crisis occured in 2007/08 has had a big impact on many market sectors, automotive included. In fact, from 2007 to 2013, the sales in Italy of mopeds and motorcycles have shown a trend in free fall (around -70% of annual sales volume in six years), but in 2014 an encouraging stabilization has been noticed. The phenomenon can be generalized, even though less pronounced, in all major European markets. In such a context, it is very difficult to leverage sales volume, hence improving the operating efficiency of all company processes is a priority in Piaggio's strategic plan. For this purpose, one of the many actions taken on this trail by Piaggio is the funding of a project aimed to improve the sales forecast process, which is the main subject of this thesis, and where Business Intelligence represents the most important resource to pursue it.

Sales forecasting is a complex process that involves several departments of the company. It is executed month by month, with the aim to draw out the expected monthly results in terms of sales volumes and economic amounts (revenue, cost, margin, etc). Improving the sales forecast must be intended in two ways. On the one hand, it means to formalize, structure, automate and integrate the process in the information system. On the other hand, it refers to an enrichment of the information assets, and an enhancement to reporting and analytics tools for data generated by the process itself.

The focus of the project concerns the part of the process related to the commercial area, and takes care about pricing and promotional campaigns steps.

The project expects the realisation of a BI application aimed to support operationally the planning of pricing policies and marketing initiatives, a data model suitable to hold the collected data and make them suitable for reporting, and finally a reporting platform to evaluate from different perspectives the results of this planning.

BI team activities pass over the entire lifecycle of the application, from the requirements analysis, through the application design, implementation, testing and deployment. Technical aspects and implementation are mostly cared by an outsourcing company. Our discussion reflects this modus operandi, and it focuses on functional and software engineering aspects. All the project is developed adopting SAP solutions, and a space of this dissertation is dedicated to the architecture and technological aspects.

Outlines

This thesis is organised as follows:

In **Chapter 1** is shown the project context, namely a brief introduction to the Piaggio Group, the economic environment in which it is playing, the reasons driving the company to develop this kind of projects, and the role that business intelligence has in the organisation.

In **Chapter 2** is described the sales forecast process in Piaggio. The focus is on business functions and business users involved. We highlight steps considered by the management to be improved, and the analogies between sales forecast and sales budgeting.

In **Chapter 3** is shown the requirements analysis phase. In particolar, we describe the methods of requirements gathering, and the formalisation of the business process and logics required by the business users.

In **Chapter 4** are shown architectural aspects of the application. Moreover, we describe the information system infrastructure hosting the application, based on SAP solutions. The architecture includes three main application modules, and each of them is explored in the following three chapters.

In **Chapter 5** is shown the module, based on Business Planning & Consolidation (BPC) tool, provided for supporting the planning phase of the sales forecast, such as pricing and promotional campaigns planning.

In **Chapter 6** is shown the data model necessary to hold the data generated by the planning activities, and to make them suitable for reporting and analysis. The focus is on the multidimensional model description.

Finally, in **Chapter 7** are shown the reporting tools provided to the sales manager to support the profitability analysis.

Chapter 1

Project context

Starting with a brief historical excursus, we present the Piaggio Group company in its evolution up to the present day, giving an idea of its size and its business model. By analyzing some data, we make some consideration about the current macroeconomic context and market trend which the company has had to face in recent years. Moreover, let us see the management goals put in place by the company and the role that business intelligence plays in the achievement of these objectives.

1.1 Piaggio overview

Perhaps not everyone knows that Piaggio born as a ship fittings company, founded in the 1884 by the young Rinaldo Piaggio, son of the entrepreneur Enrico. Nowadays, Piaggio is often confused with the brand Vespa, which actually was conceived 60 years after the institution of the society. The founder have never seen its born (1946). Until that moment, Piaggio had ranged over the areas of railway construction and aeronautics, riding the industrial boom that characterized Italy at the begin of the XX century and answering subsequently to the needs of traditional transportation like ships and trains dictated by the Great War.

The concept of Vespa represents a big turning in the business model of Piaggio and nonetheless had a big impact on the transportation of the country. After a slow and complicated start due to the scepticism toward this new means of transport, in 2 years was produced over 10 thousands Vespa and in the next 7 years they have reached 2 million of produced units. Almost simultaneously Piaggio started the diffusion on the market of Ape, answering to the needs of goods transportation of an Italy destroyed by the Second World War.

During the subsequent years, the company, became single sector, have been

facing a swinging period of expansion and crisis. In the latest years, it has walked on a path of growing, acquiring and relaunching the famed brands Gilera (1969), Derbi (2001), Aprilia (2004), Scarabeo (2004) and Guzzi (2006).

Today Piaggio Group, led by the president Colaninno, controls 7 brands of two-wheeled vehicles (Piaggio, Vespa, Gilera, Derbi, Aprilia, Scarabeo and Guzzi) and 2 brands of commercial vehicles (Ape and Piaggio-Commercial Vehicles). The Group works worldwide in the sector of 2 wheels vehicles (scooter and motorcycle) and in the sector of light commercial vehicles (both three and four wheels) and furthermore is leader in Europe in the market of 2 wheels vehicles and one of the most important players of 3 wheels vehicles in India.

The organizational structure is separated in 3 main commercial responsibility: EMEA, Asia Pacific 2W, India. Actually there is another particular business unit in China, characterized by a management not centralized like the other ones, being the result of a joint venture with the Chinese motorcycle company named *Zongshen*. The responsibility of EMEA includes all the European and American markets and it is divided in two-wheeler and commercial vehicles. The responsibility in India has the same splitting, whereas Asia Pacific 2W, including Vietnam and some other minor markets in that area, concerns only the segment two-wheeler. In Fig 1.4 we give us an idea of how the business is distributed in the world.

It is interesting to observe, although sales volumes of EMEA and India are almost the same, there is a big gap in terms of turnover. This fact shows somehow the difference in terms of prices between Asian market and western one. About that, in 1999 Piaggio built a production plant in India [Gro] and in 2009 another one in Vietnam [Gro09] in order to be more competitive on production costs.

In Vietnamese market Piaggio has penetrated in the segment 'Premium' especially with the brand Vespa. Nowadays, Vietnam two-wheeler is one of the most

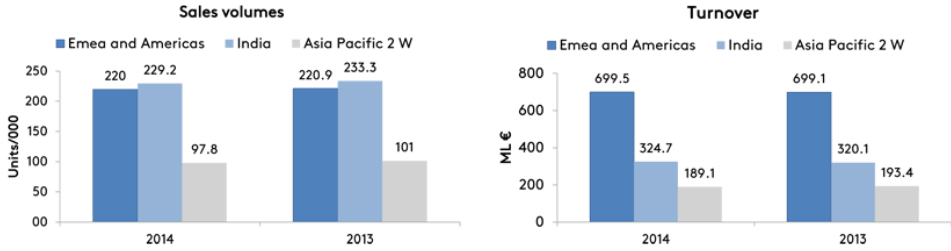


Figure 1.1. Actual results overall in volumes and turnover

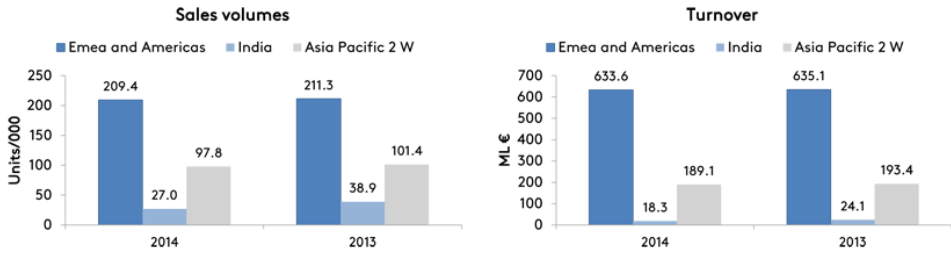


Figure 1.2. Actual results two wheels segment in volumes and turnover

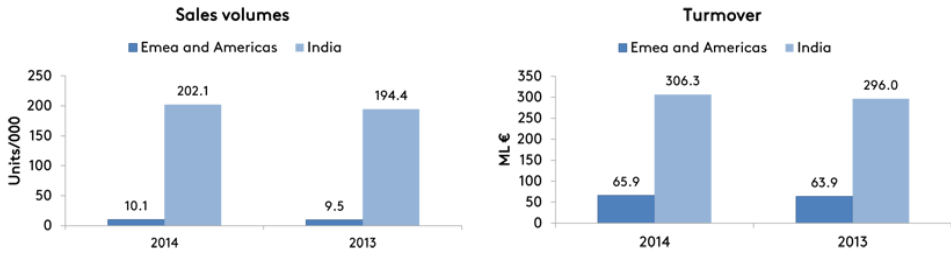


Figure 1.3. Actual results commercial vehicles segment in volumes and turnover

important market of Piaggio, with a sales volume equal to about half EMEA.

In India Piaggio has totally moved the production of Ape, taking a significant position in the commercial vehicle market.

Regarding the personnel, Piaggio counts about 7500 employees of which 4000 in Italy. The worldwide production is structured in 6 production centers, 3 of them in Italy and the others in China, India and Vietnam. In addition to these, there exist a commercial headquarter in Usa and one in Indonesia. In Italy the main headquarter is located in Pontedera, while in Lecco there is the plant of Moto

Guzzi and in Scorze' (VE) the plant of Aprilia.

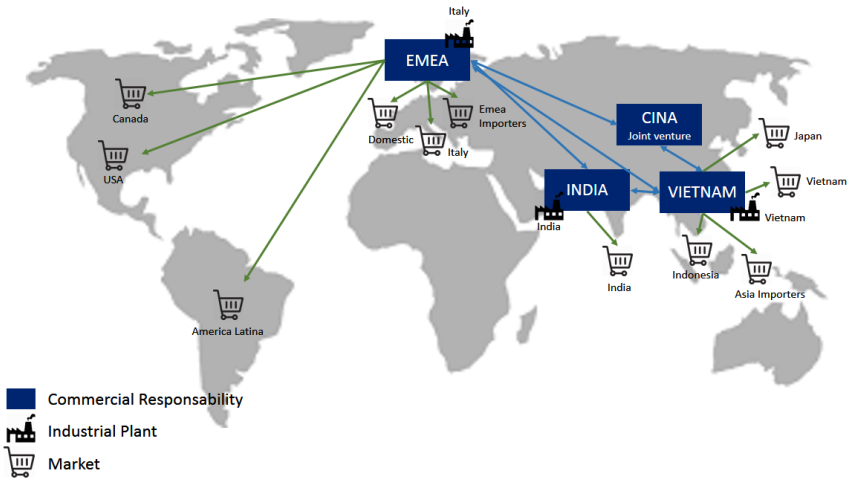


Figure 1.4. Corporate structure of the company

1.2 Market trends and management goals

At the end of 2014, due to the stabilization of the economic situation, the two-wheeler sector registered a slight decline in demand (-1.5% of the total branded motorcycles and mopeds in terms of units). This is the result of a modest increase of badged motorcycles and a further significant decrease of the moped market. These data bring a sigh of relief for the industry, which finally could see positive signs from the sales of different segments of motion, but it is a scant consolation given the low levels of the market volumes reached from 2008 to 2013. In fact, in the previous 6 years, the cumulative loss in volume was close to 70%, that is from almost 600 thousand pieces sold in 2007 to 185,000 in 2013. Therefore, the importance of the data in 2014 is to limit the meltdown, but it is not enough for a market cut down to the bone [Fin15b].

Looking at the sales in Italy of mopeds and motorcycles, we observe a trend in free fall from 2007 to 2013. The 2014 is a year of stabilization. Distinguishing the two cases, we see in particular that the motorcycle market is characterized by a slight increase compared to 2013 (1.5 %), meanwhile the trend of mopeds remained negative even if more limited than 2012 and 2013 (-16.1 %).

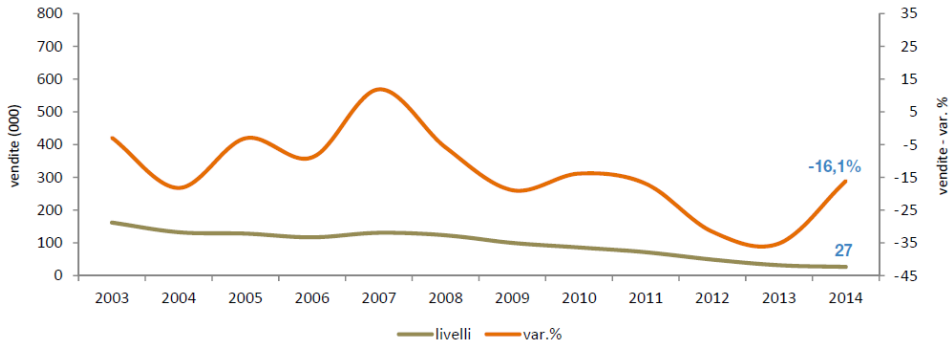


Figure 1.5. Moped sales in Italy, volume and percentual variation. (Source: L'Osservatorio Findomestic)

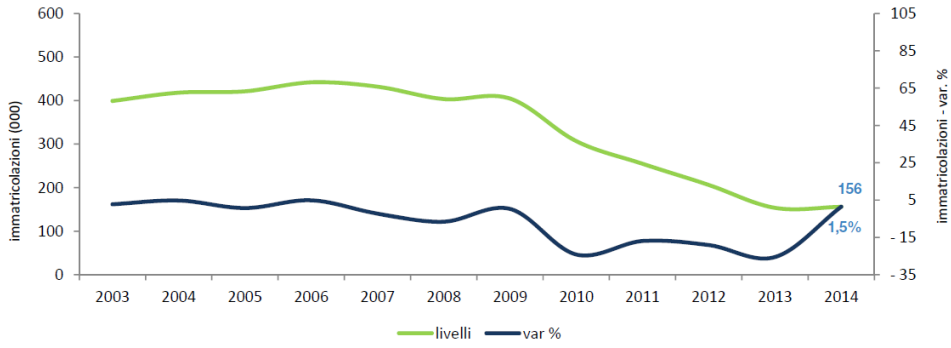


Figure 1.6. Motorcycle sales in Italy, volume and percentual variation. (Source: L'Osservatorio Findomestic)

The phenomenon can be generalized, even though less pronounced, in all major European markets. Despite this slump, Piaggio has been maintaining in recent years the leadership in Europe for two wheels.

In 2014 the share of mopeds fell to 24.8 % [Fin15a], then we note a slight decline under pressure from major competitors Honda and Yamaha [Ser14]. It remains the leadership position even in the generic two-wheeler market with a share of 16.1 %. The defense of this position is one of the main objectives that have characterized the management of recent years in Piaggio [Gro15].

Much more blooming is the situation in the Asian markets. The Asian expansion had begun in 1999 with the starting of the Ape production in India. From the 35000 models assembled in 2003, nowadays the production has growth until 150000 pieces per year.

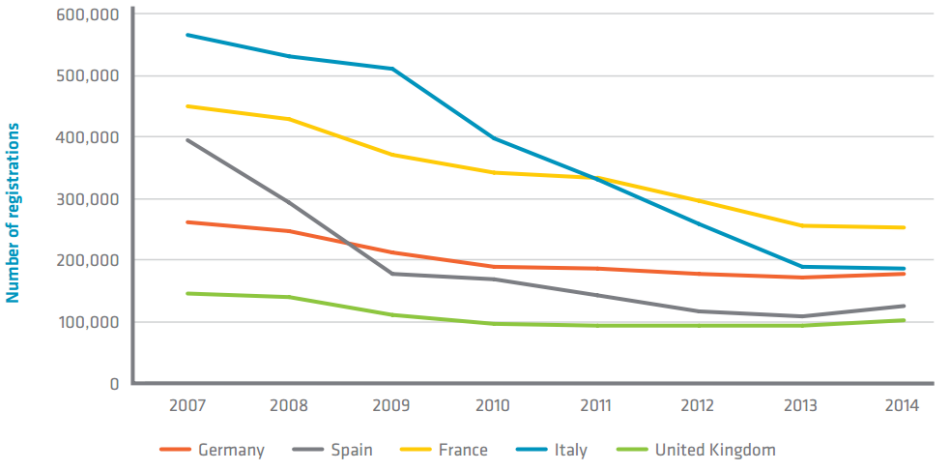


Figure 1.7. Moped sales in Europe, volume and percentual variation (Source: L'Osservatorio Findomestic)

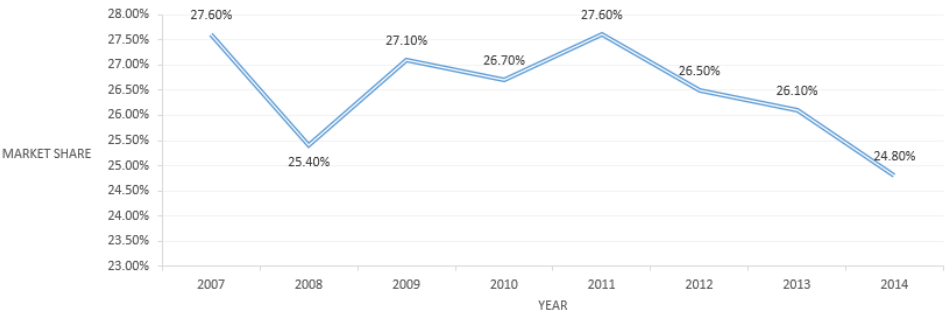


Figure 1.8. Piaggio market share of mopeds in Europe

On this track, in 2009, Piaggio has landed in Vietnam starting the production of Vespa, intended for sale in the local premium segment. The strategy proved successful and the market in Vietnam is now one of the most important markets for Piaggio.

In such a context the Piaggio Group aims to create value by adopting a strategy which:

- consolidates its leadership position on the European two-wheeler market and on the Indian light commercial vehicles market;
- increases its presence on international markets, with particular reference to

the Asian area;

- increases the operating efficiency of all company processes, with a focus on industrial productivity.

Regarding the first objective, Piaggio proposes to enrich the own products gamma. On the hand it offers the renewed gamma Moto Guzzi and Aprilia, on the other hand it will try to penetrate on the market of the electric bikes leveraging the leadership technological and of design.

As for the second objective, Piaggio intends to expand further in the Asian market (Indonesia, Thailand, Malaysia, Taiwan) by replicating the strategy of Vietnam and consolidating its position in India.

In the pursuit of the third management objective, take on a particular relevance the information system of the company, for supporting both the operative activities and the processes of decision making.

It is quite easy to realize the importance that the information system plays in such a big organization. The development and the maintenance of the information system is provided by the department IT. In particular, the support to decision processes is done by the unit of Business Intelligence, which take care about the development and the maintenance of applications for measuring and analyzing business phenomena.

1.3 The role of Business Intelligence

Business Intelligence is a generic term that refers to a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision making. For this reason, different companies can interpret this tool in a different way, depending on the core business, organizational structure or a specific business policy. The first issue that a company has to face with is the quantification of the costs and benefits to invest in business intelligence, especially if it is in support of strategic activities.

The main aim of this section is to understand how Piaggio company interprets business intelligence, what results are expected to obtain due to it and how it is used to pursue one of the most important objectives of the current management, that is the improving of the efficiency of all business processes.

In Piaggio, as typically happens, we can divide the company's information system into two parts: the transactional system and the directional system. The transaction system is an ERP (Enterprise Resource Planning), namely a system of business process integration that serves as a support to all operational activities as well as to satisfy all the information needs. The directional system instead is the platform on which developing applications to support management decisions. This

system is the main working environment of the BI group. The whole environment is signed SAP, the global leader in the development of ERP and BI tools. The directional system or datawarehouse is called SAP BW (Business Warehouse).

The activity usually starts with a listening of the needs of the management. Because of the size and the type of the organization, the needs may be of different nature and of different innovation degree, depending on the department in which the request is born. Piaggio can be seen as the most traditional of the organizational structures. It is a manufacturing company operating from over 60 years in the automotive industry. It deals with design, development, marketing and sales of motor vehicles. For this reason, to support our explaination, we can refer the classical value chain model of Porter [Por08], that well represents the company.

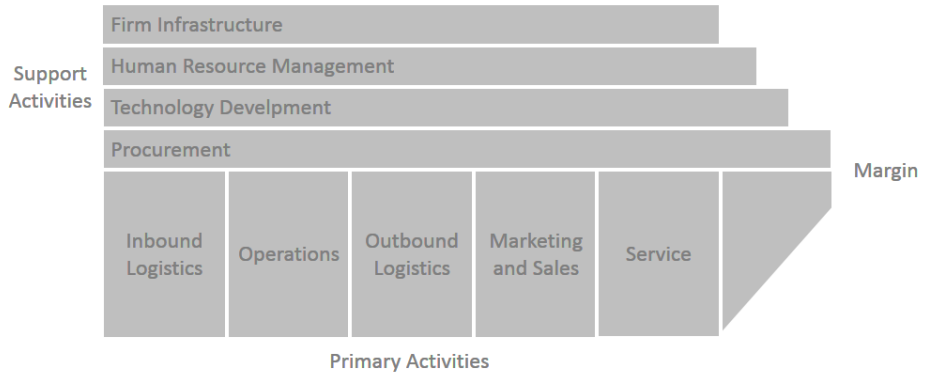


Figure 1.9. Porter's Value Chain

The unit of BI is collocated as a support service, specifically in the firm infrastructure. Actually its activity is transverse over all the business processes of the company, both the primary and the support activities.

Each activity in Fig 1.9 represents, from the point of view of business intelligence, an infoarea. An **infoarea** is a semantic field in which are built business intelligence applications designed to monitor certain phenomena. Each infoarea is continuously evolving.

For example, in the *HR* infoarea there are data models and reporting tools to monitor the processes of human resource management, therefore related to recruitments, trainings and improvement of personnel.

In *procurement* infoarea there are analysis tools for purchases of direct and indirect materials, with a focus on the analysis of supply defectiveness and supplier scoring.

There are also infoareas for monitoring *logistics* flows both materials and distribution of products. In recent years, those have been massively developed given the global expansion both commercial and production terms.

There is an infoarea dedicated to the production (*operation*), in which is monitored the flow of materials and semifinished products in the manifacturing lines. Moreover, it is monitored the state of the finished product, for example assembled, approved, stored.

Needless to say, there is an infoarea dedicated to monitor *sales* volumes and revenues. In addition, we have an infoarea dedicated to after sale *services*. This makes particular reference to the product warranty service. The warranty is an important issue because it represents a significant cost for the company. For this reason, several analytical and dealer (commercial intermediaries) scoring tools are been developed.

A very important infoarea especially for the purpose of our project is dedicated to support the processes of *planning and control*. Planning and control is an activity that is part of the firm infrastructure. Simplifying it is the set of onerous processes and methodologies of budgeting, forecasting, and variance analysis. The project discussed in this thesis takes place in this infoarea. It is an evolution of the current instruments designed to operationally support the market planner, nonetheless to make available tools of economic analysis for the forecasting.

As we can see, the scenario is very heterogeneous. The requirements arising from the various areas of management are varied and often informal, but fall essentially into four types:

Data extraction : This is the most basic of the activities for the team BI. In this case, the processing of data for analytical purposes is totally kept in the requesting department. In fact, in the same department, there are competent actors able to manipulate these data. Therefore, there is a distribution of the activity of BI in the department itself. From the BI unit are expected only activities of ETL (Extraction, Transformation, Loading). Usually data are presented through a flat file like Csv or Excel format, according to the request.

Report : This type of requirement stems from those managers who require static and institutional reports, which are always presented with the same layout. The reporting tools allow to make use of some elements of dynamism as filters or selection on the data, but the level of customization is very poor. The tool typically used for this kind of project is SAP BO (specifically Web Intelligence, which allows to access reports through any browser).

Olap : One of the most traditional BI practices concerns the multidimensional

analysis, which is usually referred with OLAP (OnLine Analytical Processing). It consists of observing a business fact distributed along different dimensions of analysis. For example, the company could be interested in looking at sales distributed along time, geographic areas and customers.

This type of task is required by managers who like exploring data without a prefixed rail, but with the possibility of observing data from different points of view, in order to discover anomalies or interesting trends. The instrument typically used for this kind of analysis is SAP Bex, which is an OLAP engine based on Excel interface.

Advance analytics : Thanks to increasingly sophisticated data mining techniques, algorithms and statistic-mathematical models, new possibilities to extrapolate knowledge from data arise. In particular, knowledge that would be difficult to catch with the classical models of BI. Most tipical examples of applications could be classification trees, clustering, analysis of sequential pattern, association rules and so on and so forth. These types of analysis are currently the most uncommon. Hardly a director requires a similar application. One cause is that it requires quite advanced technical skills to be proposed or understood. Another cause is that the results of these developments are uncertain and there is no guarantee that the investment will bring tangible informational benefits. Development tools are SAP Predictive Analytics and KNIME.

Gathering and formalizing these requirements is performed by the BI central group. Any of such request involves very often the development of an ETL flow and a database, if necessary with star schema, in SAP BW environment. The design and development of such structures are often delegated or performed in cooperation with external consultants. The BI group is the guarantor that data are presented to the managment in a simple way, consistent, adaptive as much as possible to changes and safe.

Chapter 2

Business review: improving sales forecast process

The purpose of this chapter is to describe thoroughly the context in which the project, object of study of this thesis, was born. The reasons staying at its root are strongly related to the need to enhance the planning and control infoarea. We will focus our attention on the business processes involved.

As previously said, one of the main management goals of Piaggio group is to improve the performance of all the business processes, in respect of the current market scenario. In particular, in this historical phase of the European two-wheeler market, the company has to focus attention on its internal structure and aims to reorganize and optimize its own assets and processes. The project, born following a business review, finds its location in the infoarea of planning and control. In this area, two main processes are involved: Budget Financial Planning and Sales Forecast (for the sake of simplicity we referred to them with budget and forecast, respectively). The project wants to be a support tool to the **Sales Forecast** process (also called Commercial Forecast), from which comes the title of this thesis. We are going to illustrate the budget and forecast processes, whose analysis is fundamental for setting the development of the project.

2.1 Planning and control

The planning and control systems are a necessary requirement for the survival and development of any company. The strategic planning is a company's process of defining and implementing its strategy. Whereas, management control systems are the formal, information based routines and procedures managers use to maintain or alter patterns in organizational activities.

The planning activity is made explicit in analytical and operational terms by the budget process. The **budget** is the process of setting company policy which have to be put in effects as part of the strategic choices made. In other words, it can be defined as a program of action, expressed in quantitative/monetary terms, which cover a period of one financial year.

The forecast process shows many similarities with budget. In fact, it is a planning process too, but its aim is to develop a more realistic and accurate planning that is updated monthly during the financial year. Therefore, while the budget defines the targets as goals to be achieved, the **forecast** estimates the results that the company can effectively reach.

The forecast therefore opens the door to the activity of management control, as it allows to carry out a preliminary analysis of variances with the targets set in the budget. Also lets eventually to act promptly, even at the operating level, to perform corrective actions.

To do this kind of analysis we need a reporting tool, which actually is an important part of the development and will be discussed in Chapter 7.

The analysis of variances between actual results and budget references is then performed in quarterly cycles. For the moment it is outside the scope of the project, although the integration of the actual data in this project is an important evolution to take into account.

The two processes of budget and forecast are therefore very related, because the data generated in the budget represent the starting point of the process of forecasting. In the following sections we give a description of these business processes.

2.2 Budget Financial Planning

Budget financial planning is the process aimed to build a quantitative expression of a plan for the entire coming financial year. It may include planned sales volumes and revenues, resource quantities, costs and expenses, assets, liabilities and cash flows. It expresses strategic plans of business units, organizations, activities or events in measurable terms.

This is an onerous and complex process developed during the last trimester of the year and involves several department of the company. Giving its deep description falls outside our purposes. We consider only the steps of the process related to the commercial area. Therefore, starting from the description of the sales budget where volumes are set, we describe the steps of economic figures assignment like pricing and costing to obtain the standard margin.

2.2.1 Sales budgeting

Sales budget is an important part of the general budget of the company. It is the basic budget because it affects the budgets for other departments such as production budget, cash budget, personnel budget, etc. Sales budget shows the estimated amount of sales for the coming financial year.

Sales budget serves as a measuring device to inform management as to how far the company is making the desired progress towards the achievement of the predetermined objectives. It serves as a control device presenting the standard against which actual performance can be measured and a control mechanism for the sales volume.

There are several factors to take into account for preparing sales budget. Some of these factors are internal, namely they concern and are within the control of executives. Some examples may be: sales volume of the last year and the sales trend, production capacity, seasonal changes, etc.

Other factors are external, therefore outside the company and they are a great extent uncontrollable. To this kind of factors belong: general trend of industrial activities, change in population, policies of the government, competition position, etc.

2.2.2 Pricing

Pricing is one of the most important and decision process that has to be faced by a company [PDP09]. It is a crucial factor of marginality, nonetheless influences the consumer demand and market positioning. That is why essentially the sales planning cannot be strictly sequentially antecedent to the pricing, rather is an iterative process seeking an equilibrium.

The price generally should also cover costs of production, promotion and distribution, in order to benefit from an appropriate margin.

For Piaggio, as declared in the strategic objectives, the maintenance of market position is critical, so the pricing policies are oriented to the maintenance of market share, being very important in terms of appearance and perception by investors, eventually eroding the margin of certain product lines.

The pricing definition depends on market, as the competitive arena and demand change from country to country. From the organizational point of view, there is an actor called market controller, responsible for defining prices of the market within its competence.

2.2.3 Costing

Costing is the second critical aspect to deal with. It consists in the determination of a standard cost to be allocated to a product. There are different approaches

pursued based on the level of detail you wish to achieve.

Piaggio adopts an approach based on *direct costing* [AGLL14]. This means adopting a cost calculation system which imputes to the product only the direct costs of production. Therefore the indirect costs, such as electricity or administrative costs, are not allocated to single products with some logics of distribution, but are retained at aggregated level.

The alternative approach of allocating indirect costs is called full costing, which can be very costly to be sustained depending on the complexity of the productive organization. The idea is to determine to what extent a generic cost, as may be the administration cost, has to be charged on products. For instance, my own expenses would be allocated with logics of imputation on products and a very tiny slice of this would end up in the standard cost of the Vespa.

With the direct costing approach instead, indirect costs are not allocated to the product, but they will be subtracted from the total revenues in the assessment of overall marginality.

Distribution costs are considered indirect not attributable to the individual product, even though different groups of products actually suffer higher costs due to export. The system of cost calculation pursues a level of detail appropriate to meet the information needs of management. Introducing complexity in the model must be justified by a need for decision making purposes, otherwise it will represent only an unnecessary cost.

The standard cost is mainly the result of decisions occurred before the process of costing, relating to labor and supply of materials and services (purchasing department). Actually there are factors poorly controllable that affect the cost, for which we must make an estimation, such as the effects of a currency exchange in the case of imported materials, or the failure of a supplier.

The standard cost is also a property of the product and does not depend on the market where the product is sold, unlike the price does.

2.2.4 Promotional campaigns budgeting

A special treatment is reserved to the cost of promotional campaigns. Promotional campaigns is the leverage available to the market controller to implement the business strategies, but this should fall within certain boundary defined at budget. The purpose of this step is to define such references for market controller to lead its activity.

Unlike the definition of the reference price and cost, in the case of promotional campaigns the main effort will be moved to the forecast, because the campaigns are a very dynamic element and they are actually structured month by month.

2.3 Sales forecast

Forecast is about predicting the future as accurately as possible, given all of the information available, including historical data and knowledge of any future events that might impact the forecasts. This process is performed at the begin of each month and two properties must be hold as much as possible: accuracy and timeliness.

Forecasting is an integral part of the decision making activities of management, as it can play an important role in many areas of a company. Again we consider only the steps of the process related to the product marginality evaluation, retracing a path similar to the budget description above.

Thus, we focus attention on the sales planning, but mostly on the step of promotional campaigns definition, in order to be able to determine an expected margin to compare with the standard one.

2.3.1 Sales planning

Sales Planning is the process executed month by month aimed to improve, on the basis of the context changing, the estimated amount of sales fixed in phase of budgeting. In other words sales planning is the monthly process in which the budget volumes are reviewed on the basis of the evolving scenarios. Clearly there can be several factors that induce to change the sales forecast for a certain product, for example changing trends of the customers, market actions of the competitor, production capacity, etc.

During the financial year, the sales planning of the month of January will be adjusted one time, that of February two times, that of March three times and so up to that of December that will be put right twelve times. The budget instead only once per financial year.

In this case we referred to sales strictly in terms of volumes able to be absorbed by the market. These quantities are obviously fundamentals for managing the production, supplies, logistics, stock and many other aspects, but it arises necessary for directional aims to understand what is the economic result which this volume will lead in.

2.3.2 Sales planning evaluation

"What is the expected margin of Vespa?"

"What is the expected margin of Vespa in Italy and Germany?"

"Will the margin of Vespa achieve the margin planned at budget?"

These are representative questions that, to be answered, need transforming the foreseen volumes in economic quantities. Sales planning evaluation is a set of activities aimed at achieving this goal from the forecast volumes. The first step is a review of the budget data in terms of costs and prices. Then there is the step of defining the promotional campaigns.

Price and cost data review

To manage the unavoidable approximation applied in phase of budget and to treat the unpredictable events occurring during the year, it is necessary to review month by month the budget data in terms of costs and prices.

Fortunately the load of the effort regarding the determination of prices and costs has already been absorbed at budget, because these quantities are fairly stable during the year.

Promotional campaigns definition

The promotional campaigns definition is instead critical issue to be addressed. It is the most dynamic element to be determined in the process. Whereas changes in prices and costs even if present are limited, the promotions and in particular their economic impacts on product may introduce changes much more significant. It is the main lever by which the commercial area can implement their strategies, which actually may also include other areas such as inventory management or finance.

It is a complex procedure, given that different kind of campaigns exist and are associated to different strategic reasons (see Section 2.3.3). In general, the information needed to be defined in this phase can be traced in the following points:

- **master data** of the campaign (name, type, period, market and other properties);
- **products** involved in the campaign;
- **incidence**, namely the percentage of the volume expected actually affected. This index is necessary to model campaigns which are essentially rewards for dealer based on sales results, obviously not sure to be achieved;
- **percentage of discount** applied to the price.

This activity has to be performed by an actor called market controller. After those begins a phase of analysis of the economic impacts and validation by the market management.

2.3.3 Promotional campaigns model

The integration between business process and information system requires the process is well formalized. The formalization of decision making processes in Piaggio is defined by the business users in collaboration with the business intelligence team. The formalization of the process in this project is one of the critical challenges, as it involves having to define logics and rules shared by actors, who until now had partial decisional autonomy.

In this sense, the definition of the campaigns, which is a protagonist step of the forecast, is a critical point, as the parameterization of these, as well as the assessment of the economic impacts on the product has many discretionary elements. The complications arise considering the articulation of promotional campaigns under the model Piaggio.

Piaggio has a commercial network based on commercial dealers that are not directly controlled by the company, but whom it has a collaboration relationship with. Every product is affected by a **basic discount** which is essentially a contractual discount stipulated between Piaggio and a specific dealer. For example such dealers offering exclusivity to the brands of Piaggio will enjoy an higher discount.

During the planning, the basic discount is considerate at level of market, essentially like it would be a weighted average of the basic discounts stipulated with the dealers. The value obtained deducting the basic discount to the gross sale is named sales net basic discount. In addition to the basic discount, the price of the product is impacted by the promotional campaigns that are dynamic during the financial year.

The promotional actions are classifiable in two kinds: Sell-In and Sell-Out. **Sell-in** refers the selling to the dealers, instead Sell-Out refers the selling to the final consumer. Therefore Sell-In concerns those campaigns hitting the dealers, typically on the basis of the volume sold by them. This kind of promo is not directly accessible by the final user, given that the dealer will be free to manage the discount and to decide how far to shift on the consumer such advantage.

Sell-out campaigns are not addressed to specific dealers, but rather to the consumers and they can be about a product or a gamma products. This kind of campaigns is launched directly by the company to the people, typically not only aimed to increase the sales volume, but usually dictated by more complex strategies. For example, they can be related to the launch of new products, to the management of the stock, to the positioning in the market, to reply an action of the competitors, etc.

Another classification adopted in Piaggio divides **Promo** and **Bonus**. Essentially the difference consists in the fact that promo hit a products gamma of a brand, instead bonus is more general and refers an entire brand (for example only Scarabeo, only Moto Guzzi, etc).

A different type of promotion is called **Settlement**. The allocation of this

promotion is based on the payment timeliness of dealers, so it belongs somehow to the Sell-In campaigns.

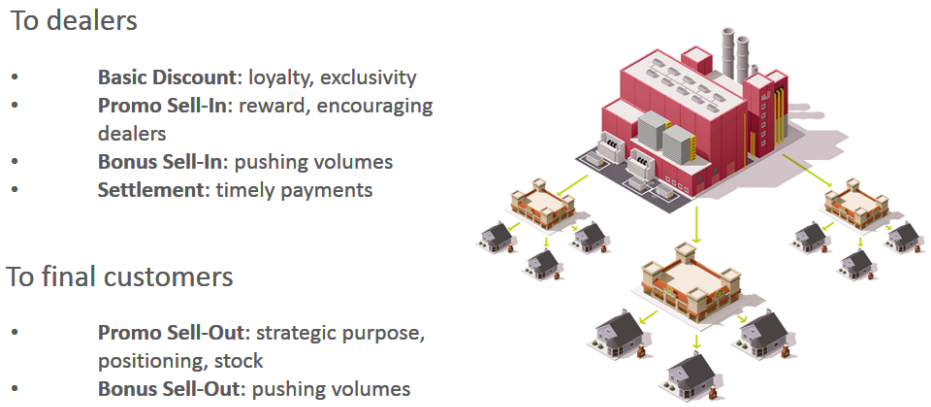


Figure 2.1. The commercial network: company, dealers and customer. On the left a list of the promotional campaign types. The first four refer the relationship between company and dealers (Sell-In), the others between dealers and final costumer (Sell-Out).

2.4 Project goals

Supporting the process of **assigning economic values to the foreseen volume** in sales planning and getting the expected margin is the main goal of the project. The pre-existent process has been considered weak by the management for different reasons. First of all, there is an heterogeneity of the process among the various markets that make difficult a consolidated analysis cross market. The risk is to compare or aggregate quantities calculated with different logics, especially dealing with foreseen quantities and not actual ones. This is a common problem in companies acting on several countries in the world. Also there are markets born as independent importers and only subsequently integrated and controlled by Piaggio.

Furthermore the process of sales planning evaluation has been considered weak for the missing of a real formalization and for the missing of an integrated tool for supporting the business users in their operational activities involved in pricing review, cost review and campaigns definition.

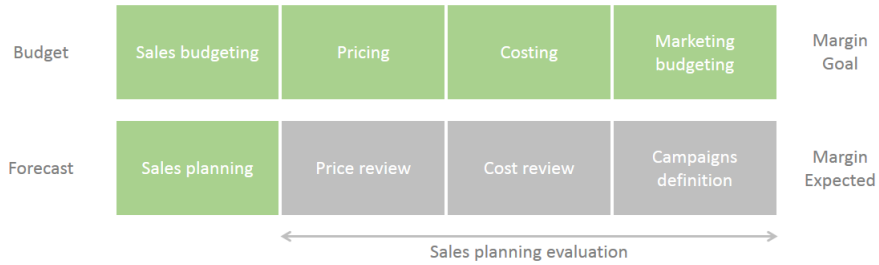


Figure 2.2. A comparison view between the steps at budget and those at forecast related to the product marginality evaluation. In grey are shown the steps considered by the management to be improved.

The main aims can be summarized in the following points:

- **Structuring and formalizing** the process of sales planning evaluation;
- **Automatizing and improving** the performance of the process of sales planning evaluation and reducing possible human errors, so giving an operating support;
- **Unifying** the process cross market;

Achieving those objectives will allow new kinds of reporting and data analytics. The data generated by the new process related to different markets will be comparable and aggregable coherently. Nonetheless the future report and tool analysis will enjoy of a better performance and consistency of data generation.

In conclusion, the project *commercial forecast* will provide a supporting tool for the entire process. It will lead the business users along the correct review of prices and costs, along the definition of promotional campaigns and along the evaluation of the economic results. Moreover, it will provide a reporting tool of **profitability analysis** and comparison between forecast results and budget references.

Chapter 3

Requirements analysis

This chapter is dedicated to the description and formalization of the business requirements. First of all, we describe how the requirements have been gathered and the methods of interweaving with the business users. After that, we give a formalization of the business process described in the previous chapter. In particular, we restrict our vision to those steps that concern directly the project, namely those for which it will be developed a supporting tool. Finally, through suitable formalisms, for each step we define the expected logic, in order to limit as much as possible the ambiguities during the subsequent phases of application design and development.

3.1 Overall approach to requirements definition

To better understand business requirements, we begin by talking to business users. We have to consider what the business needs in parallel with the availability of data to support these requirements. It is a balancing work, but if we consider one without the other, we risk a big fail.

In the following sections, we are going to describe the results of the business user meetings. These meetings are a sort of **interviewing sessions**. They tend to start out as informal discussions with knowledgeable project team members.

Once the users start talking about consistent themes, it is time to formally sit down with the data experts and get into the thorny details of their source systems.

Here we try to understand whether the data are there to support what users are asking for and whether the data are complete and reliable. This step is conducted by the BI team, when necessary supported by some data audit interviews. We try to understand if traps are hidden in the data. For example, there might be indicator fields that were never populated or were labeled one thing but then used for something completely different. These kinds of risks can explode when years of

hystory are loaded into our data warehouse.

After having gathered enough baseline information to understand the general business and its vocabulary, we found really useful to organize **facilitated sessions** with business users. This approach consists of scheduling larger group sessions led by a facilitator, in our case the BI project manager.

Facilitated sessions can be used to encourage creative brainstorming with a limited number of participants. They have been proven essential to share and validate with the business users several logics, necessary to proceed with the application design.

Just think about the process part of the campaigns definition, which in this chapter, we will see in detail. In fact, we had to define logics, especially for calculating the the campaigns economic impacts, shared by all the European market controller. We talk about more than 10 people (essentially one for each European country where Piaggio is playing), who used to apply those logics independently each other.

Facilitated sessions allowed the debate among the market controllers themselves, a debate oriented by the facilitator to eliminate all the ambiguities that may have a significant impact on the application design.

Although they require a greater time commitment from each participant, facilitated sessions can actually reduce the elapsed time required to gather information, assuming you can schedule a convenient time to meet with ten to twelve people within a reasonable time period [Kim98].

3.2 Business process formalization

The analysis starts with a formalization of the business process that we are aimed to support. An overview of the process is represented in Fig 3.1. In this section we identify each step that will be supposed to be supported operationally by the application.

The process begins with a set of activities referable with **budget data review**. This set of activities involves: product gamma review, standard cost review, and price review. Product gamma review is a step aimed to resolve the gamma discrepancy between budget and forecast, due to different reasons that we will see in detail. Cost review is a step aimed to refine month by month the budget standard cost definition, exploiting the new knowledge about the ongoing context changing. These steps are performed by an actor called *material manager*. Price review, that is the first step related to the commercial area, is analogous to the cost review, and it is performed by an actor called *market controller*. Once the budget data review is completed, every market controller is responsible to define **promotional campaigns** on its reference market. After having defined the promotional campaigns, begins a phase of economic effect analysis of them. This step can culminate in

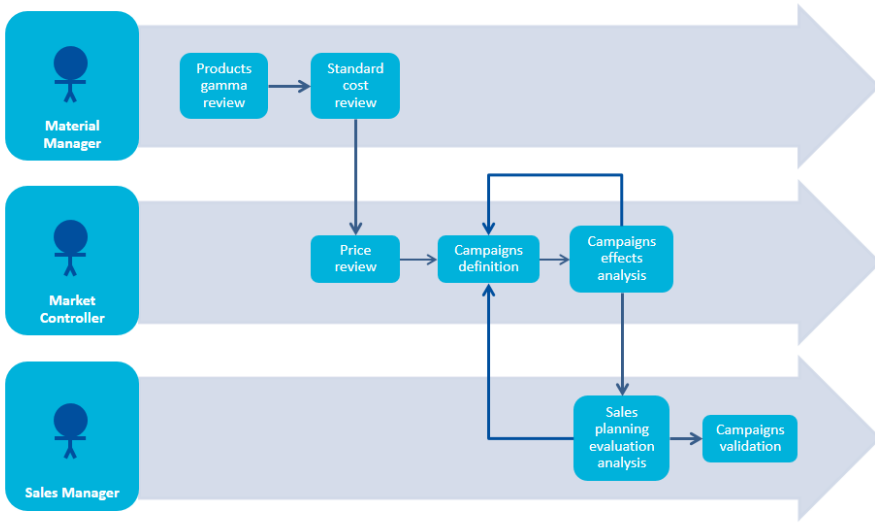


Figure 3.1. Business process for sales planning evaluation

two ways, either the analysis leads in an acceptable scenario and can proceed at management level, or the scenario is not satisfactory and it is necessary to go back and to revise the campaigns again.

In the latter case, the process loops in these two steps: promotional campaigns definition and economic effect analysis. Whereas, in the first case, the process goes ahead and here the *sales manager* comes into play. The output, in addition to be a proposal for carrying out promotional actions, is a database which allows kind of analysis very hard to perform so far. In particular, this holds for consolidated analysis cross market, where the procedures of data collection and analysis were heterogeneous and poorly integrated, especially for some markets.

This phase, in fact, called **sales planning profitability analysis**, puts together all the pieces of the puzzle, prices, costs and campaign effects, eventually coming from different markets, in order to observe marginality from multiple perspectives of analysis. This final step requires essentially a reporting tool for data visualization.

If the sales manager does not accept the scenario, the process turns back to the promotional campaigns definition. Otherwise, the process paves the way for making operational the validated campaigns.

3.3 Actors

The process hits directly 3 actors that represent the business users of the application. Besides these figures it is worth mentioning another role that is somehow involved, the sales planner, who develops sales planning of a specific market, an important part of data input of the application.

The sales planner is aimed to plan the sales volume on the market of his competence. It is the actor in the company mostly immersed in people thinking. His purpose is understanding and predicting as precise as possible the trend of the market of his responsibility.

The **material manager** is the expertise of the products gamma of Piaggio. It represents the role in the company mostly skilled for determining the standard costs. Mantaining this kind of information is a complex work, enough to consider that the products gamma includes thousands of products organized in a hierarchy of 8 levels.

This phase has revealed an organizational weakness, namely the missing of an actual responsible figure for defining the standard costs cross market. Till now, this activity was performed in a distributed way amongs the different markets. In order to simplify, let say that could happen Vespa having two sligthy different standard costs in Italy and Germany. This just because they were defined by two responsible people, who used to apply two slighty different logics.

Not necessary a logic is better than another, but we must make coherent these logics when we perform a marginality analysis cross market.

The **market controller** has the role to make explicit the commercial policy of the company in a specific market. In particular, he is responsible to review the price for each product and to define the promotional actions to play out. Therefore, he will be one of the main recipients of the application, or at least the figure who mostly will benefit of the operating support of the application. Italian and French market are the ones targeted for testing, in the perspective of acting the deployment on each european market.

The **sales manager** will be the actor who makes a cost analysis against the proposed campaigns by the market controllers, with a global point of view cross market. Finally, he will validate the desirable campaigns, making them feasible.

The sales management is divided in three commercial responsibilities, which represent essentially group of markets: EMEA and Americas, Asia Pacific 2W, India. The management of EMEA represents basically the promoter of the project and includes every European market. Hopefully, in the future, the application will be deployed in India and Asia too, according to the standardization of the process.

3.4 Budget data review logics formalization

The preliminary analysis has led to formalize the business process and to define the actors involved in such process. This phase has revealed some organizational problems like the missing of a figure responsible of defining the standard costs cross market. Not seldom structuring the process in the system brings out organizational weaknesses.

For structuring operationally the process, it is necessary to understand the logic by which any actor works and what functionalities they expect to get. In particular, we have firstly to understand the logic by which the material manager performs the product gamma and costs review. Secondly, the logic by which the market controller defines prices, campaigns and their economic effects. Finally, we have to understand the kind of analysis which the sales manager expects to be able to perform for validating the proposed campaigns and taking future decisions.

The following sections are aimed to describe the results emerged in the meetings attended with the different actors.

3.4.1 Product gamma review

A problem that comes to light in the forecast during the phases of price review and cost review is the presence of variations in the product gamma itself. In other words, it can happen that some products that has been planned in the budget remain unsold, and some products that are not been considered at budget appear instead in the forecast. The second one is the more problematic situation.

Recall that the steps of cost review and price review take as input their corresponding budget values, which represent the starting point. From these values in fact, a more precise assessment occurs, according to the new information available month by month. But what is the starting point if the product has not been defined at budget? In this case, it is necessary to understand the cause of that missing value and then to act suitably.

If for a given product without budget reference, there exists a very "similar" product that well represents it in terms of price and cost, this case is managed in this step.

It is a quite common case, due mostly to the emerging of small variants of the main existing products. For this reason, we have decided to formalize this step and to provide a supporting tool to perform it. The objective of this step is, in fact, to establish references between the product and a similar one defined at budget. In this case, we talk about **confluence** and the two products will be treated as a unique in the subsequent evaluation, in term of price and cost.

Example: Vehicles UK
A very explicative example can be the case of the vehicles sold in UK. They are essentially identical to those ones sold in the other markets in Europe, but they have the light oriented in a different way because of the inverse traffic. Those products are identified in the system with different codes, but they should be treated in the same way in terms of price and cost.

Confluences should normally be defined not just by criteria of similarity in costs and prices, but with a logical association. Confluence between A and B means that A is a product well represented by B. The material manager is responsible for establishing valid confluences among products.

In the following steps, each product for which is defined a confluence to another one, it will be evaluated with price and cost of the related product.

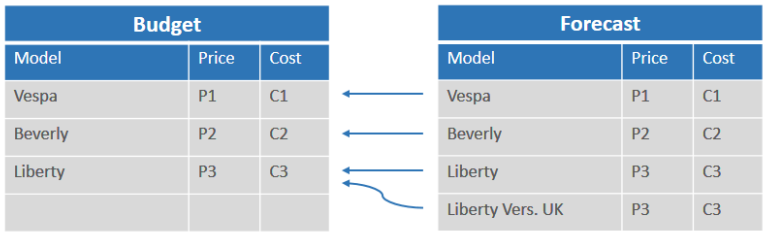


Figure 3.2. Confluence mechanism to redefine budget references of products in sales forecast

3.4.2 Standard cost review

The cost review is the step in which the material manager, starting from the budget costs definition, makes a revision exploiting new knowledge surfacing month by month during the year. The material manager expects to have, in the first instance, the costs setting defined at budget, in order to revise it nimbly.

We have seen, however, as not all products have necessarily a budget cost reference, and how the mechanism of confluences can solve the initialization problem of prices and costs of many case series. There remains the problem for those products which have not another budget product that well represents them. We can distinguish the remaining problematic situations essentially in this two following cases:

1. Products for which can be identified a referring family, although not a specific product. In such cases, it is not allocated a unique association, but it makes sense to consider the entire product family to infer cost and price.

Example: New Model Launch
When a new model is launched, this nearly always belongs to a line of products already existing and well-defined, which can be exploited to approximate the cost of the new model. Suppose that in the course of the year comes out a new model Vespa Sprint 4 Stroke, that was not budgeted. We can take advantage of similar models of Vespa as the corresponding type 2 Stroke, or approximating further we could use other models such as the Vespa LX and Vespa Primavera.

2. Products which not have budget references at all. The missing budget reference can be due to an actual lack of awareness about the sales of a product still in design stage. In this case, in phase of budget, the product is not in the market yet and its launch is not still defined for the coming year. In cases like these, it becomes very difficult to find a criterion to approximate the initial cost.

Example 1: Wi-Bike
An example may be the wi-bike electric bicycle. During the budget 2015, this vehicle was still under development and it was very difficult to make a sales budget of such a product. The uncertainty is also due to the fact that wi-bike is a totally new and innovative project, so it is difficult, in certain phases of development, to provide any deadlines for its fine tuning. Toward the end of 2015, the vehicle was developed, even though not ready for the retail channel yet. Thus, there appeared few sales volumes at forecast in the corporate channel, but it was not possible to find budget references in terms of costs and prices. It has not been possible to make a confluence to another product, nor to approximate exploiting a products line already existing, since the market of electric bicycles is a whole new arena for Piaggio.

Example 2: Obsolete Products
It may happen that a foreign importer is determined to purchase one lot of obsolete products in stock, to resell it in a market uncontrolled by Piaggio. A request like this could be unexpected during the budget and therefore no budget reference would exist for those products. Actually this case may fall in the previous one, if the family of the product is somehow considered at budget.

In order to manage the first case, according to the material manager, we developed a mechanism of **approximation by hierarchy lift**. The standard cost of the product is approximated with an average of "similar" products weighted on

volumes. For similar product we intend products belonging to the same branch of the hierarchy. In other words, we consider all the products which share the father with the product at issue. If not enough, we approximate further taking the grandfather in the hierarchy.

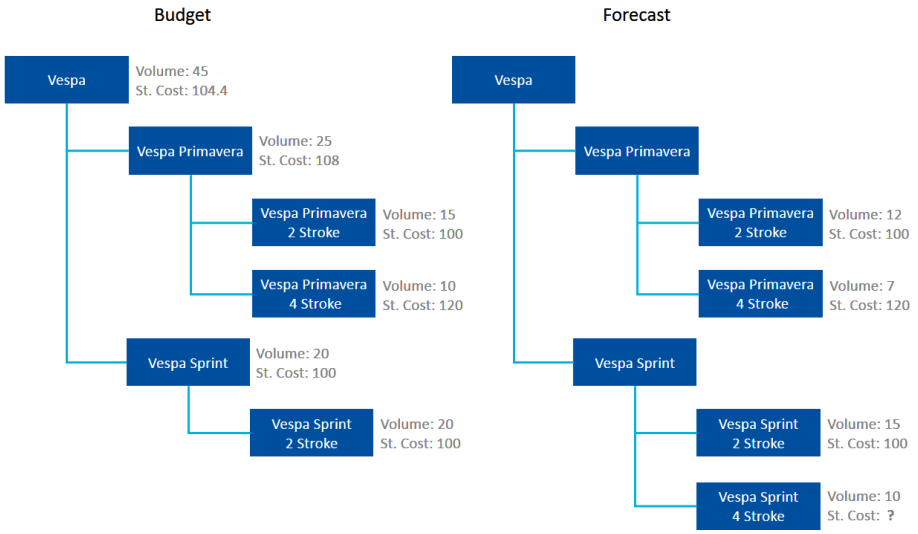


Figure 3.3. How can be approximated the standard cost of Vespa Sprint 4 Stroke?

Let us consider the example in Fig 3.3. We compare a fragment of product gamma planned at budget against forecast. We see that each product at forecast inherits the standard cost from its budget reference. Now we suppose that a new model compares in the forecast, not taken into account at budget, the Vespa Sprint 4 Stroke. The point is: how can we initialize its standard cost? The algorithm of hierarchy lift would take 100, namely the standard cost of Vespa Sprint at budget, that is computed as average weighted on volume of its child. In this case, we thank the Vespa Sprint 2 Stroke, but in general we can have many children. If Vespa Sprint did not have any child, we would consider 104.4, the standard cost of the grandfather Vespa, again calculated as weighted average. The algorithm would not lift more, because a further approximation does not make sense, as it would involve products of different lines.

Summarizing, for each product subjected to cost review, its cost is initialized in one of the following way:

1. The product has a budget reference and inherits the cost from that.

2. The product has not a budget reference, but a confluence has been established

with another analogous product, inheriting its costs.

3. The product has not a budget reference, but a standard cost can be estimated considering products belonging to the same family in the product hierarchy.

4. The product has not a budget reference at all and cannot be approximated as well.

In the last case, the only possible action is the manual input by the business user. Actually, in this case, the user should be forced to insert a value to avoid products without cost assigned.

Obviously, the manual input is always allowed in order to overwrite any value, if desired by the material manager.

3.4.3 Price review

Once the cost review is done, the material manager passes the ball to the market controller, who goes on performing the price review. Actually the logics are analogous to those ones of the cost review. In the first instance the market controller expects to have the scenario of the budget prices setting.

As for the cost review, when a product does not have a budget price reference, it may inherit that, through a confluence defined previously in phase of product gamma review, or it may be approximated by the hierarchy of lift mechanism. However, the market controller can always overwrite any value via manual input. Even better, he will be forced to insert a value for those products for which it was not possible to assign a starting value.

It is worth mentioning that prices, unlike the costs, are broken down by market. So every product will have a price for each market in which it is sold. It is possible that, for a given product is defined a budget price for Italy, but not for France. The respective market controllers will manage the data independently.

3.5 Promotional campaigns logics formalization

As already told the operating support to the campaign definition presents some complications due somehow to the complexity of the promotional system adopted by the company. Each campaign, in fact, according to its purpose, it is defined through different parameters and logic of calculation of the effects.

In order to give a formal expression of the logics expected by the market controllers, in the following we will show some diagrams, which represent the flow of the quantities involved.

The values highlighted in red are those available in the system, because inserted in a previous step or because retrieved from the transactional database. The values

highlighted in green are those expected to be inserted by the user performing this step. The values highlighted in blue are those expected as output value of the step. The values without color are just auxiliary values.

3.5.1 Basic Discount

The logic of evaluation of the effects of the basic discount is very simple. In the diagram 3.4 is represented the flow of the quantities involved in the definition of the basic discount for a certain product.

In this specific case the resulting value is essentially the sales net basic discount (unit and total). It is obtained as subtraction of the gross sales, previously defined in the price review step, and its unit basic discount. The unit basic discount actually would not be a property of the product because it is based on contractual agreements with dealers (section 2.3.3), but anyway it is estimated by the market controller using indicators and logic of distribution. Being associated to the dealers, the total basic discount is calculated on the Sell-In volume, so the volume expected to be distributed to the dealers, not to the final customers.

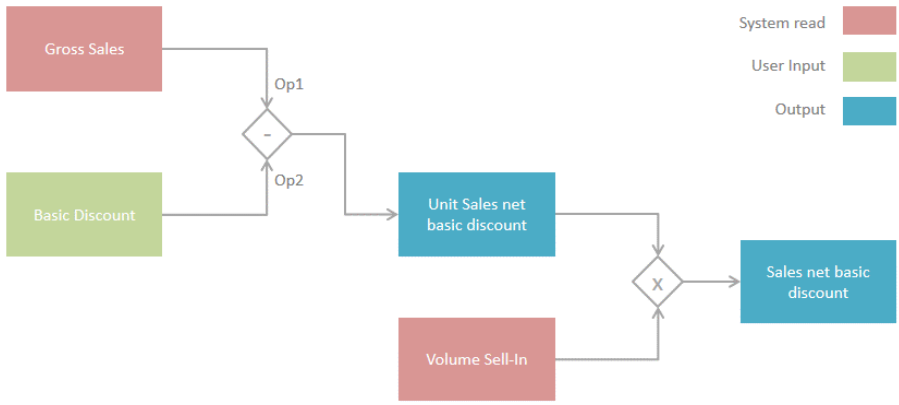


Figure 3.4. Application logic of basic discount effects

3.5.2 Promo Sell-In

To evaluate the effect of a promo Sell-In, the market controller expects to control two parameters: the incidence rate and the discount percentage. The incidence rate denotes the percentage of the Sell-In volume actually affected by the promo.

Please remember that promo Sell-In are mostly defined as award for dealers based on sales volume (section 2.3.3). Those dealers not reaching a certain result will not obtain this kind of discount, so the **incidence rate** allows to keep in consideration this aspect. Again market controller has to estimate it, defining a percentage of the volume associated to those winning dealers, and so the volume actually affected by the discount.

The **discount percentage** is instead banally to apply to the price, or better to the unit sales net basic discount. The total cost of the promo Sell-In is obtained multiplying the unit cost of the promo by the volume expected to be hit by this promo.

Sell-in volume highlighted in red concern only the **products involved** in the campaign that we are defining. Therefore it is necessary to provide a tool to define which products are involved in every campaign.

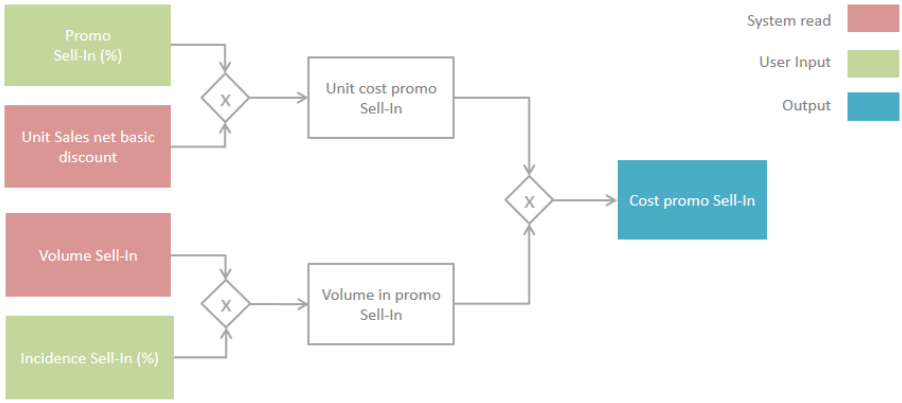


Figure 3.5. Application logic of promo Sell-In effects

3.5.3 Promo Sell-Out

The calculation logic of the effects of the promo Sell-Out is slightly different. In fact the user expects to parametrize the promo with an **absolute unit cost**, instead of a percentage of discount. The discount percentage emerges as derived result and it represents a value in output of this step. This percentage is calculated dividing the total cost of the promo Sell-Out by the sales net basic discount.

In addition to this, the user expects to define the **incidence rate**, that has the same meaning described for Sell-In.

Again we need a tool to define which **products are involved** in every campaign.

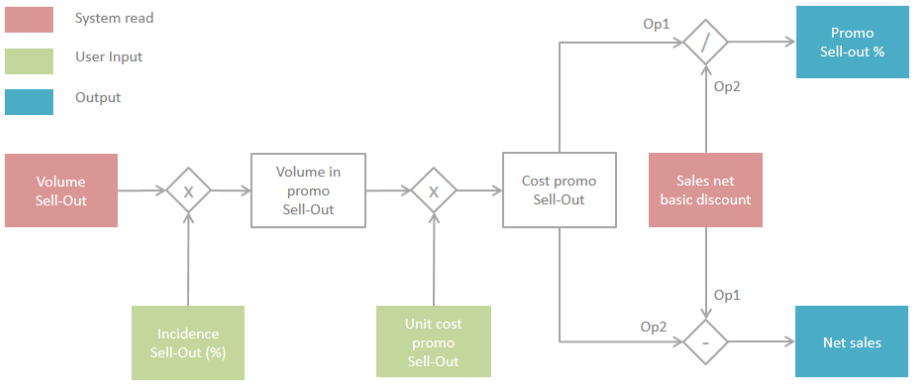


Figure 3.6. Application logic of promo Sell-Out effects

3.5.4 Bonus e settlement

For the sake of completeness, we mention bonus and settlement. They have a very simple logic because they are applied on an entire **brand** and only require the definition of a **discount percentage**.

3.6 Sales planning profitability analysis

This step concerns the sales manager and it essentially closes the forecast process. In this phase, we put togheter all the planning data collected so far, with sales planning and budget data, in order to build analytics tools to support decision making process.

The meeting in which we have defined the requirements of this step is the most sensitive, in fact, so far, the aim was mainly to support operational activities, now it is to support decision making.

At this stage, the manager area decides whether the cross market promotions plan is economically sustainable, makes an analysis on margins as well as the comparison between budget and forecast results. This is a crucial phase because it has a strong impact on the application design, since the information required by the business user at this stage represent the ultimate goal of the whole process. The held meetings make possible to identify and to formalize two fundamental

requirements, which give a clear idea of which information should be provided in the data model:

1. Sales planning profitability analysis.

   Margin on sales represents a key factor behind business considerations in budget and forecast analysis. All managers should, and generally do, know their approximate business margins, that they need for a lot of marketing decisions. Managers differ widely, however, in the assumptions they use in calculating margins and in the ways they analyze and communicate these important figures. The purpose of margins is to determine the value of incremental sales, and to guide pricing and promotion decision.

   With margin we intend *gross margin*, that is the difference between revenue and cost of goods sold, in terms of manufacturing costs and discounts.

   The manager wants to evaluate the elements that contribute to obtain the margin, and in particular, starting from revenue, he observes the impact of the promotion campaigns and production costs.

   Since we are considering the management of the commercial area, the focus is on the impact of the promotions. For this reason, the manager requests to observe the margins separating the effects of the different types of promotions (basic discount, promo Sell-In, promo Sell-Out, bonus Sell-In, bonus Sell-Out, settlement).

   This distinction is important since each type of campaign has a different goal (see section 2.3.3). We recall that, for example, basic discounts aim to reward the dealers' fidelity, promo Sell-In to push the dealers' sales volume, settlement to stimulate the on time payments, an so on to reach other objectives such as stock, launching of new products and various strategies. Analyzing separately the effects allows to evaluate if the cost incurred for a type of campaign is commensurate to the goal that is being pursued.

   From a data model perspective, this suggests that the **type of campaign** is a very important dimension of analysis.

   The manager also looks forward to the opportunity of observing the sales planning marginality, being able to choose which products to include in the analysis. To give some examples, the manager may want to observe the marginality of the line Vespa, or a specific model of Vespa, or aggregating Vespa, Beverly and Liberty.

   This suggests that the data model have to include the dimension of analysis on **product hierarchy**, with granularity level 7, which represents the individual models so called "uncolored", where the only missing detail is the color, managed at level 8.

The last recommendation of manager is the possibility of doing the marginality analysis of a single **market** or cross market. To name a few, management might want to look at the profitability of a product in Italy, or the same product in Italy, France and Germany, or the same product by aggregating all markets.

2. A comparison analysis budget versus forecast.

   Another type of analysis required by the manager is the comparative analysis of the the **budget against forecast** results. It is a fundamental analysis to understand whether the company is in the right direction for achieving the objectives defined at budget.

   The detail on the type of campaign allows to figure out if the commercial initiatives are reflecting the relevant business policies and to take prompt corrective actions on the management.

Chapter 4

Application design

In this chapter we want to give an overall view of the BI application at issue.

Firstly, we introduce the system infrastructure hosting our application, giving a high level description of its main components. We will consider not only functional aspects, but also we will talk about tecnologies adopted for developing.

Secondly, we define the conceptual model of the application in terms of structure and behavior, therefore software components involved and relations among them. In this description we recall the business process steps related.

4.1 Information technology infrastructure

The entire Piaggio information system infrastructure is based on SAP solutions. In Fig 4.1 we have a representation of the main components adopted by the company.

In the bottom layer of the infrastructure, we find SAP Business Suite software, including the SAP ERP, SAP Customer Relationship Management (CRM), SAP Supply Chain Management (SCM), SAP Supplier Relationship Management (SRM), and SAP Product Lifecycle Management (PLM).

Meanwhile CRM, SCM, SRM and PLM provide support to manage business processes in order to improve performance and optimize operations in specific corporate functions, ECC provides integration of information and processes.

Climbing the architecture we find SAP Business Warehouse (BW), the datawarehouse environment, which provides supporting for BI application development. Simplifying it offers an ETL environment, a storage service and an olap engine.

On the top of the architecture we have a presentation layer, and we can see 3 components: SAP Business Planning and Consolidation, SAP Business Explorer and SAP Business Object. These tools represent the front-end modules of the architecture. BEx and BO are presentation modules oriented for olap analysis and

reporting of data stored in BW environment. BPC is a presentation layer too, but it is specialized with functionalities for modifying data presented through an Excel based interface. In the following sections we explore a little in detail each component mentioned above.

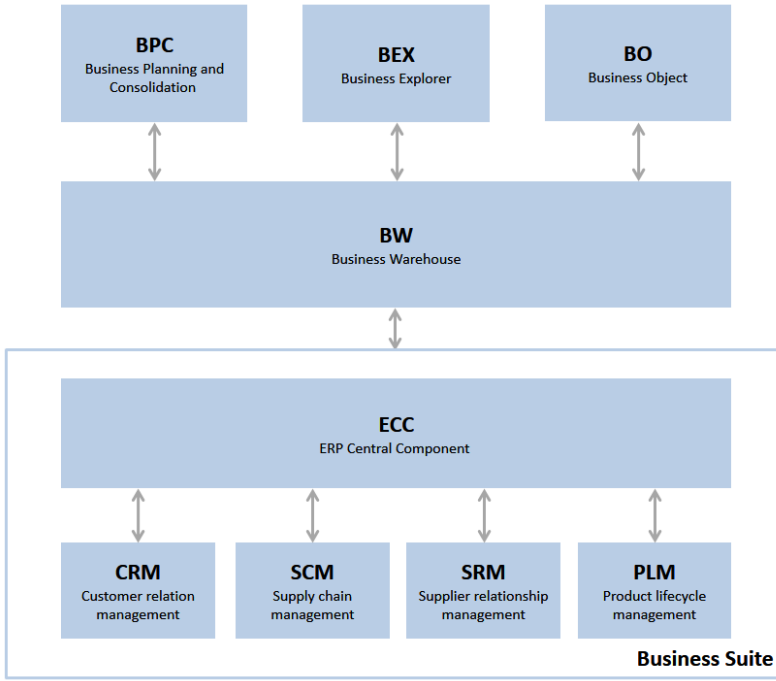


Figure 4.1. Main components in SAP architecture

4.1.1 SAP Business Suite

For years, large organizations, including Piaggio Group, have been deploying the components of the SAP Business Suite (SAP Business All-in-one in the latest releases), among which there are: SAP Customer Relationship Management (CRM), SAP Product Lifecycle Management (PLM), SAP Supply Chain Management (SCM), SAP Supplier Relationship Management (SRM), and SAP Enterprise Resource Planning (ERP). Just to give an idea about the eventual benefits derived from their usage, we briefly describe each of them. SAP **CRM** supports customer related processes end-to-end. It allows to obtain a complete view of its customers

and their various contact points into the organization. It enhances back-end functions such as order fulfillment, shipping, invoicing, and accounts receivable. SAP **PLM** is focused on facilitating rapid development and delivery of the products upon which the company's business depends for its revenue. Further, it helps companies to identify and remove productivity organizational constraints. SAP **SCM** is the most mature component within SAP's Business Suite. It aims to optimize the company's supply chain functions, including procurement, warehousing, manufacturing schedules, sales, and distribution. SAP **SRM** is a solution for managing the procurement and support of the goods and services a company needs day in and day out. Just as SAP CRM manages the relationship between a company and its customers, SAP SRM helps to optimize and manage the relationship between a company and its suppliers.

SAP ERP Central Component

The purpose of Enterprise Resource Planning (ERP) is, contrary to what is suggested by the acronym, the integration of business processes in a single software system that can meet all the information requirements of the company using a centralized database.

The company Gartner today defines ERP as "a technology strategy that integrates a set of business functions, such as finance, human resources and purchasing, with operational aspects, such as manufacturing or distribution, through tight linkages from operational business transactions to financial records".

SAP ERP Central Component, or ECC, and its predecessors R/3 and R/3 Enterprise, are online transaction processing (OLTP) systems aimed to satisfy daily transactional needs of many users.

SAP ERP incorporates the key business functions of an organization. Within SAP Enterprise Resource Planning (ERP) are a number of modules or subcomponents that provide various kinds of business functionality. Typical functionality includes finance related tasks, logistics, human resource management, customer service, quality management tasks, and many others [1].

SAP is currently the leading ERP solution vendor, both in market perception and in market share. However, it is not so undisputed in the midmarket because of complexity and cost. Its Business All-in-One solution portfolio enjoys good adoption among midmarket customers, mainly those in the upper midmarket and lower enterprise segments. SAP's vision for exploiting in-memory capabilities is strong, and it has lately started initiatives such as Fiori and Screen Personas, although these only cover parts of the very broad application. Recent announcements to simplify licensing and pricing are promising for midmarket companies that cannot

[1] For further details refer to [And11]

invest in expansive vendor management and sourcing capabilities. Taken together, these factors confirm SAP Business All-in-One's position as a Leader in the Gartner Magic Quadrant 2014, reported in Fig 4.2 [HMPG14].

4.1.2 SAP Business Warehouse (BW)

Like most data warehouses, SAP Business Warehouse (BW) is a combination of databases and database management tools that are used to support management decision making. BW allows to combine data from SAP as well as external data sources, transform data, and consolidate it. It consists of the usual layered architecture of an end-to-end data warehouse:

ETL service: which includes services for data extraction, data transformation, and loading of data;

Storage service: which includes services for storing and archiving information, it also serves as a staging area for intermediate data in ETL flows;

OLAP engine: which provides access to the information stored in SAP BW, with analysis and navigational functions like filtering, runtime calculations, currency conversions, and authorization checks;

Presentation service: which offers different options for presenting information to end users, like Business Explorer, a tool that we discuss in the section 4.1.3.

They are accompanied by two administrative architectural components: administration services and meta data services[2].

Even for BI solutions SAP is considered a global leader vendor by Gartner. Its position in the Leaders quadrant is primarily based on two aspects. SAP is investing heavily in a visionary product direction with SAP Lumira and has good product scores that have improved with the new release, and it has introduced its simplification strategy for the BI platform components. However, SAP continuously gets below average scores in almost all areas of customer experience and business benefits achieved, and has had limited success to date in addressing business user data discovery requirements. SAP must translate its visionary investments into momentum and an improved customer experience to remain a Leader in the future (Fig 4.2) [LSHS+15].

[2]For further details refer to [MWDI02]

(a) ERP Solutions (b) Business Intelligence Solutions

Figure 4.2. Gartner Magic quadrant

4.1.3 SAP Business Explorer (BEx)

SAP BW presentation services layer includes some components for presenting information available on the SAP BW server. Relevant in Piaggio is the traditional Microsoft Excel based Business Explorer (BEx). Actually, BEx can be consider as a stand-alone application and it consists of several components: BEx Query Designer, BEx Analyzer, BEx Web Application Designer, BEx Formatted Reporting, and BEx Mobile Device Support.

BEx provides a flexible reporting and analysis tool for decision making support. Multidimensional reporting and analysis performed in SAP BW are based on a query definition stored in the Meta Data Repository. Queries provide access to multidimensional data structures (e.g. InfoCubes), as well as flat information table (e.g. ODS objects and master data). Historical and current data can be evaluated at various levels of granularity and from different perspectives.

Queries are defined in the Business Explorer **Query Designer**. It allows with a graphic approach to define both tabular queries and multidimensional queries. The latter lets to access OLAP functions just by dragging and dropping the desired objects into the query results area.

Once customized queries are created, they can be run from the Business Explorer **Query Analyzer**. This is an analytical, reporting and design tool implemented as an add-on to Microsoft Excel combining the power of SAP BW OLAP engine with the features (e.g. charting) of Microsoft Excel and the VBA (Visual Basic for Applications) development environment. It provides the typical functions

of selecting a query, saving changes, refreshing data, formatting the query layout, and of course, navigating through the results of the OLAP engine.

4.1.4 SAP Business Object (BO)

SAP Business Object is a BI Suite focused on the front-end side. The portfolio can be divided into 3 main functional parts: Discovery and Analysis, Dashboards and applications, Reporting.

Discovery and Analysis tools include: SAP Visual Intelligence, SAP Business Objects Explorer, SAP Business Objects Analysis, SAP Business Objects Predictive Analysis. They allow essentially acquiring, manipulating, and visualizing data in a very flexible way, oriented to data discovery, with full capabilities of the underlying multidimensional database. Moreover they open up advanced analytics based on data mining tecniques.

Dashboards tools include SAP Business Objects Dashboards and SAP Business Objects Design Studio. They are data visualization software that allow to create and export interactive dashboards. These dashboards can contain various components, such as charts, graphs, and buttons, that are bound to data sources.

The reporting category is oriented to distribute information throughout the organization. Reporting category includes: SAP Crystal Reports and SAP Business Objects **Web Intelligence** (WEBI). WEBI approach is widely adopted in Piaggio. It is quite accessible and optimized for creating and modifying reports by business users too. It allows to design reports over the web, or using a desktop client.

4.1.5 SAP Business Planning & Consolidation (BPC)

The Fig 4.1 shows also a module called BPC (Business Planning and Consolidation) which as we will see, has a very important role in the development of this project.

BPC is a set of functionalities that allows to collect, analyze, and store financial data, and displaying accurate live data from the database through familiar tools like Microsoft Office tools like Microsoft Excel worksheets, Microsoft Word documents, and Microsoft PowerPoint slides[3]. The Interface for Excel is the primary interface, complemented by features of the Interface for Word and Interface for PowerPoint. It offers formulas and functions to retrieve, display, and submit data for a real-time view of the financial position of our organization.

We can distinguish reports and input schedules. With BPC **Reports**, we can retrieve requested data from the database into the Excel interface. We can analyze multidimensional data using the current view.

[3] *Interface for Office* in https://help.sap.com

With BPC **Input schedules** we are able to send data directly from our spreadsheet to the databases. Data can be written to base-level members to which we have write access. Input schedules contain all of the same formatting and functionality as reports.

The basic difference is that reports are used for analysis purposes, and input schedules are used for writing data to the database. There are predefined reports and input schedule templates that we can customize to meet our specific business requirements[4].

Summarizing, BPC allows to analyze data in reports, perform data entry in input schedules, and distribute information based on Microsoft Office applications.

4.2 Application architecture

In the previous section we have seen a high level view of the Piaggio IT infrastructure and all its main components. We now give an architectural description of the application and see how it is supported by this infrastructure.

We can divide our application into 3 main parts: one concerning data review and planning support (BPC), the data model (BW), and reporting side (BO).

By referring the process described in chapter 2 and the requirements analysis in chapter 3, should be clear, at this point, the activities of business users and data involved in these. Let us match them with the technologies discussed in the infrastructure above.

The activities of budget data review and promotional campaigns planning are performed respectively from material managers and market controller. These are manual activities of **review and planning**, where the amount of data generated and accessed is limited. BPC is the most appropriate tool in the infrastructure to support such activities, because it provides an approach of access and data generation based on Excel spreadsheet. It is a suitable approach to manage manually small quantities of data, nonetheless business users are familiar with it.

To support these activities must be necessarily set up a database for information retrieval and storage for new data entered. Some of these data structures are already existing and also used in other contexts, such as those containing budget data related to volumes, costs and prices, or those relating to sales planning. Other must instead be designed, in order to meet the reporting request of market managers. This is the reason because a new **data model** has to be designed, its implementation is developed on BW environment.

Once realized the BPC support and implemented the data model on BW, we can focus to the development of **reporting** for the sales manager. The requirements

[4] *Reports and Input Schedules* in https://help.sap.com

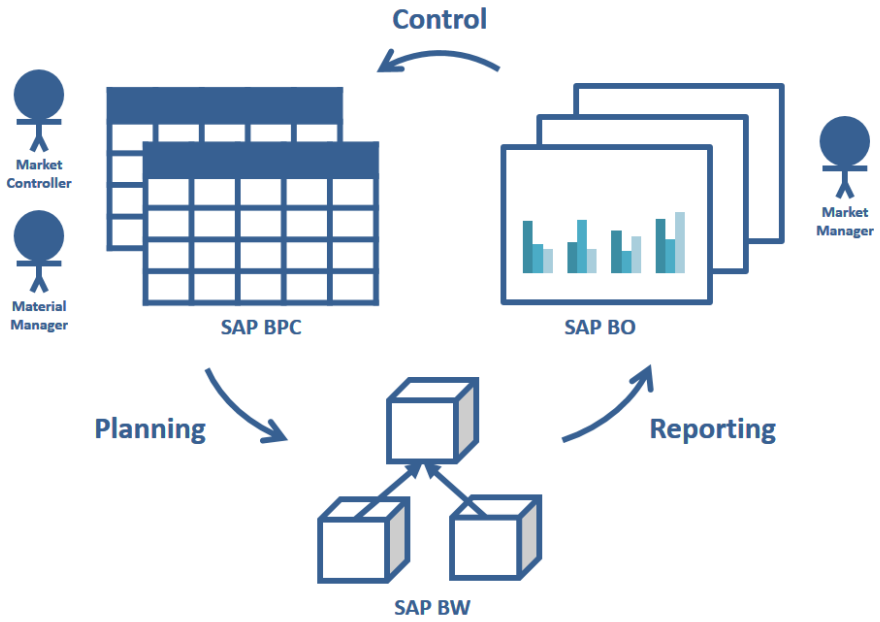


Figure 4.3. Application architecture

from managers, defined in the Section 3.6, are implemented through WEBI, a tool of the Business Object suite. This tool is the corporate standard for developing institutional reports which have a clearly defined layout and the prospect of not being modified in the short term. In other cases, for instance oriented to data discovery, are not required rigid and structured reports, and the company adopts other tools like BO Explorer, or just BEx Analyzer.

Summarizing, market controllers and material managers are able to perform the budget review and planning of campaigns through a BPC application based on spreadsheet Excel interface. The collected data will be hosted in the datawarehouse BW and, through the etl flows, they will be organized into multidimensional structures intended to the reporting. At this point, the sales manager will have at his disposal analysis tools suitable for making future decisions, and for controlling over the market controller activities.

In the following chapters we discuss separately the three main parts of the application.

Chapter 5

BPC Front-end

Aim of this chapter is to describe the front-end application from the side of material manager and market controller. The front-end application is characterized by a set of BPC input schedules to be sequentially performed according to the formalized business process. We will analyze each business process step through its supporting BPC screen, referring to the corresponding requirements analysis and focusing our attention on the design choices. These steps are performed in parallel by several users, essentially one for each country in which the company plays. This fact presents some difficulties with respect to deployment, in terms of technology distribution, education and communication support to users. We will see how the BI team has faced this aspect.

5.1 Template layout

Although the various schedules present different features and purposes, we have opted for a policy of consistency to design a standard layout, in order to never disorient the business user in its activity. For this reason, we have designed a layout that factorizes the common functionalities of each schedule, and we have tried to comply with its as much as possible during the development.

Now, we describe the template shown in Fig 5.1 with a top-down approach. At the top, we find a dark blue band with the Piaggio Group logo and two buttons: *Refresh* and *Send Data*. These buttons represent the function of opening and closing the activity, in fact, the refresh data button retrieves the necessary information from the database and initializes the schedule content. Whereas, the send data one submits to the database the new data fill in by the user. Below, we have a gray band with the title of the activity that is taking place. Coming down, we find a dark blue band which we have reserved for any filters on the data retrieved.

Examples of filters can be market, brand, and type of campaign. In any case, the filters usage is supervised by an authorization check mechanism, configurable from the BPC administration panel.

Finally, we have a table with the heading highlighted in blue in which there is specified the semantics of the corresponding column. Each entry of the table is an instance which, in some cases, represents a product, and in others a campaign. Whereas, the columns are the properties of the instance, that can be editable or not. For this reason, there are white and light blue cells. White ones represent the user manually editable cells, while the light blues are read-only cells.

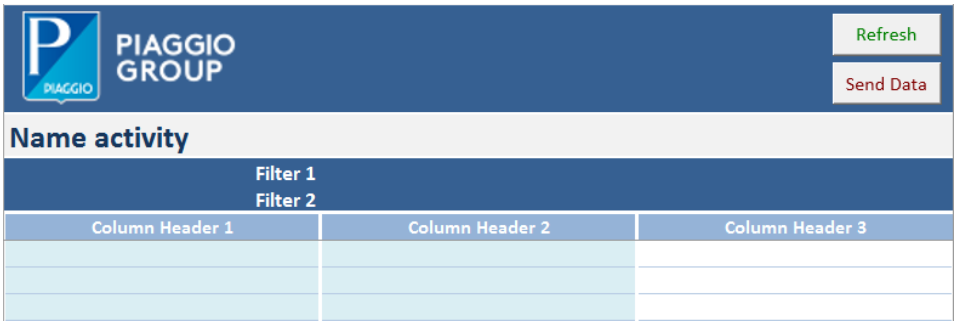


Figure 5.1. Template layout for input schedules

As a general rule the user must first choose possible filters on data involved in the activity. Then, the user must press the refresh data button to load data in accord with the selected filters. At this point, he must carry out its planning or data reviewing as he would make in any normal spreadsheet. The difference is that are not permitted operations that alter the layout structure, such as removing or inserting new columns. At the end of the acticity the user presses the send data button for submitting data to the system.

5.2 Material manager front-end

Just to recall, let us show in Fig 5.2 the steps of which the material manager is responsible. The activities involved are products gamma review and standard costs review. Let us describe their supporting input schedules in details.

5.2.1 Products gamma review

Fig 5.3 reports the input schedule for products gamma review. Each entry in the table represents a forecast product: the first 3 columns are respectively the code

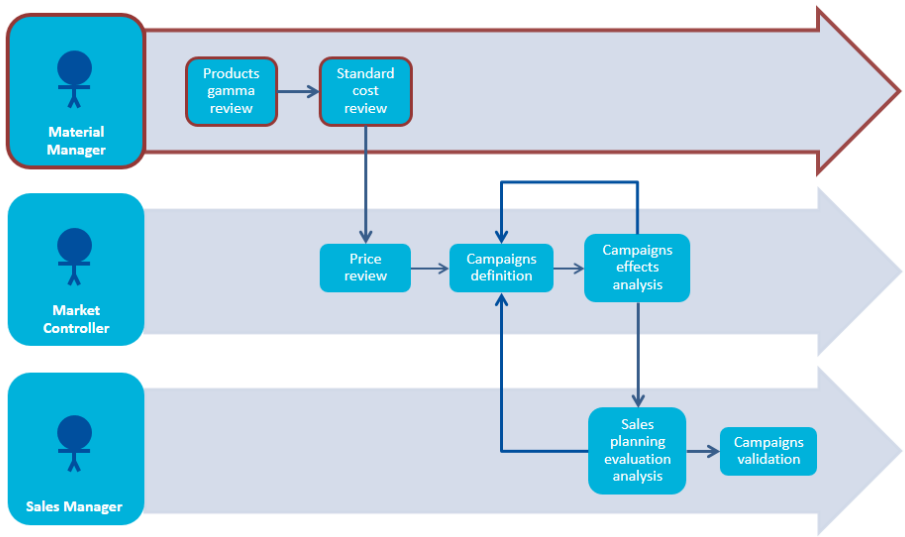
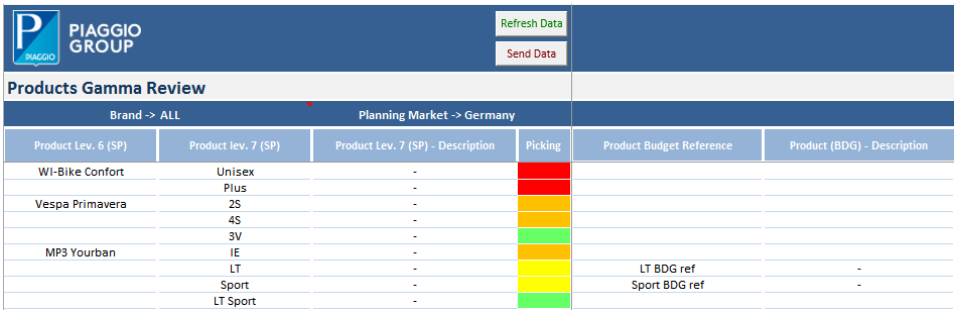


Figure 5.2. Business process for material manager

level 6 and 7 in the product hierarchy, and an informal description. The fourth column is the picking column, its values are colors that represent the type of matching with budget products gamma. In particular, the green color is associated to those forecast products having a perfect matching with a planned budget product, and from which it is possible to inherit costs and prices. The orange color indicates that it is not possible to identify a perfect matching with a budget product, but there are similar budget products that can be used to approximate costs and prices. The red color is used for those products that have no reference to budget products and for which it is not possible to approximate cost and price with an acceptable accuracy. Concerning the latter case, it will be necessary, in the following steps, to define manually costs and prices. Finally, when a confluence is been defined, the product is colored in yellow, and the last two columns show the budget product to which it refers. All this reflects essentially the logics formalized in Chapter 3. There is also the possibility for the user to select brand and market filters. In this case, the filters customize the visualization to the material manager who can carry out the review for priority by market or brand. However, it should be emphasized a fact: the confluences do not depend on the market, namely once a confluence is defined, it is valid for any market. Since we are evaluating if a forecast product has a corresponding product planned in the budget, if this happens, it must be true regardless of the market.



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Refresh Data

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Products Gamma Review

Brand -> ALL | Planning Market -> Germany

Product Lev. 6 (SP)	Product lev. 7 (SP)	Product Lev. 7 (SP) - Description	Picking	Product Budget Reference	Product (BDG) - Description
WI-Bike Confort	Unisex	-			
	Plus	-			
Vespa Primavera	2S	-			
	4S	-			
	3V	-			
MP3 Yourban	IE	-			
	LT	-		LT BDG ref	-
	Sport	-		Sport BDG ref	-
	LT Sport	-			

Figure 5.3. Input schedule for Products Gamma Review

5.2.2 Standard cost review

After the products gamma review, the material manager proceeds with the review of the standard costs, for which he has a dedicated input schedule, reported in Fig 5.4. In this schedule, there are 3 filters and 6 attributes. Each entry in the table represents a forecast product, which, as for the gamma review, is identified and described by the first 3 attributes. The *Unit Standard Cost - Budget* attribute reports the standard cost defined in the budget for that product. These products are essentially those that were identified from green color in the review gamma. In fact, for those products having the cost approximated (orange) or derived from a confluence defined by the user (yellow), the budget value does not exist. Examples are Vespa Primavera 3V and MP3 Yourban IE in Fig 5.4.

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Refresh Data

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Standard Cost Review

Brand -> ALL | Planning Market -> Germany

Version -> 1

Product (PO) Lev. 6	Product (PO) Lev. 7	Description	Unit Standard Cost - Budget	Source	Unit Standard Cost - Reviewed
Vespa Primavera	2S	-	€ 100.00	Manual Adj	€ 110.00
	4S	-	€ 100.00	Manual Adj	€ 90.00
	3V	-		Lev 6 AVG	€ 200.00
MP3 Yourban	IE	-		Confluence	€ 150.00
	LT	-	€ 100.00	Budget	€ 100.00
	Sport	-	€ 100.00	Budget	€ 100.00
	LT Sport	-	€ 100.00	Budget	€ 100.00

Figure 5.4. Input schedule for Standard Cost Review

The *Source* field indicates the criteria used for determining the value of forecast (field *Unit Standard Cost Reviewed*), namely if it is a result of an approximation, a confluence, or a budget perfect matching. For products with perfect matching in the budget, the standard cost budget corresponds to the standard cost reviewed. If

the user manually modifies it, the source assumes the value of Manual Adjustment. The operation of manual adjustment is always possible and, in such a case, the new value overwrites the previous one.

5.3 Market controller front-end

The flow of the market controller's activities is recalled in the Fig 5.5.The flow includes price review, campaigns definition, and campaigns effects analysis. In regard to campaigns effects analysis, market controllers will be provided with the reporting tools discussed later in the Chapter 7, thus the same of the sales manager, but with restrictions on local data to their reference market, dictated by the mechanism of authorization checks.

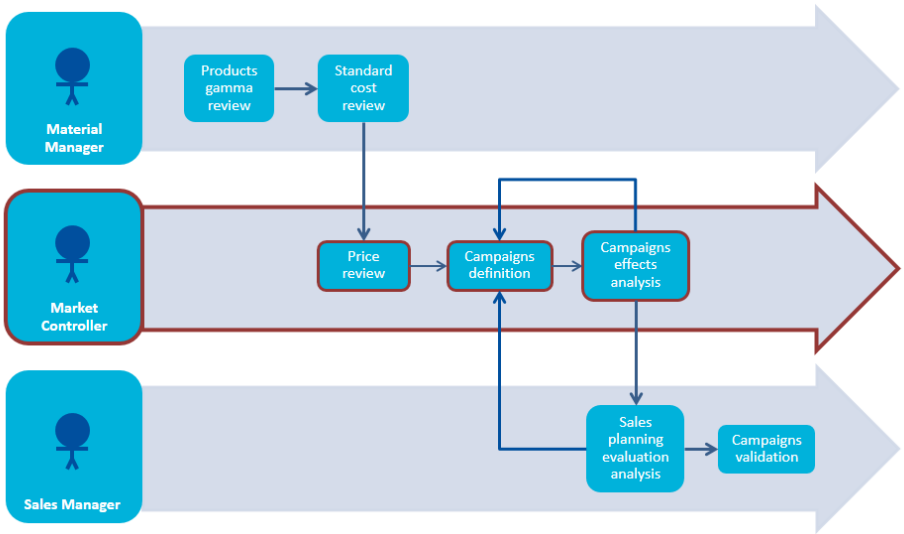

Figure 5.5. Business process for market controller

5.3.1 Price review

The activity of the market controller begins with the price review. It is an activity that has several similarities with the cost review. Each entry of the schedule represents a forecast product with granularity of level 7 in the product hierarchy. The first three columns are needed to identify it, as for the previous schedules explained. We observe the presence of three filters: brand, market, and channel.

Channel represents the distribution channel and can take two values: *retail* or *corporate*. They are respectively for products sold to final customers or products sold business to business.

About the market filter, although it appears also in the cost review, here it has a very different semantics. In fact, the price of the same product can vary market by market, depending on the local pricing policies. So, while in the cost review the filter market has the usefulness of streamlining the visualization and prioritise the most important markets, in this case it determines actually for which market defining the prices.

We have an attribute for the price currency, given that amounts are expressed in the reference country currency. Then, we find the forecast Sell-In volume, both total and detailed by month. In the example, it is reported only the month of November for simplicity of representation, but actually the application shows all the remaining months of the year. Within each month expanded, it is possible to make the price review. According to the users, we have decided to include at this phase the definition of the basic discount, because in the company's culture the reference prices are those after subtracting the basic discount. Summarizing, for every month we have the detail of forecast *Sell-In volumes*, two editable attributes for the price (*gross sales*) and the *basic discount*, the *source* that has the same semantics described in the cost review, and the *net basic discount*, calculated as the difference between gross sales and basic discount.

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Refresh Sheet | Send Data

Price review - Year 2015 - PO12

Brand -> ALL | Market -> UK | Channel -> Retail

				2015 Total	2015 November				
Product Lev. 6 (SP)	Product Lev. 7 (SP)	Description	Market - Currency	Sellin volumes	Sellin volumes	Gross Sales - Vehicles	Basic Discount (%)	Source	Sales (Net Basic Discount)
Vespa Primavera	2S	-	UK - GBP	100	10	€ 200.00	10.00%	Budget	€ 180.00
	4S	-	UK - GBP	90	8	€ 220.00	10.00%	Confluence	€ 198.00
	3V	-	UK - GBP	95	7	€ 220.00	10.00%	Confluence	€ 198.00
MP3 Yourban	IE	-	UK - GBP	50	5	€ 500.00	10.00%	Budget	€ 450.00
	LT	-	UK - GBP	50	4	€ 500.00	10.00%	AVG Lev 5	€ 450.00
	Sport	-	UK - GBP	55	6	€ 550.00	10.00%	AVG Lev 6	€ 495.00
	LT Sport	-	UK - GBP	40	5	€ 600.00	10.00%	Budget	€ 540.00
	D3	-	UK - GBP	45	5	€ 650.00	10.00%	Manual Adj	€ 585.00

Figure 5.6. Input schedule for Price Review

5.3.2 Promotional campaigns planning

At this point the activities of budget data review can be considered finished, to open up campaigns planning. The market controller has a schedule for each type of campaign expected by the model (see Section 2.3.3). As preliminary activity, planning requires to define the master data of campaigns on the transactional

system SAP ECC. Currently, this activity is not integrated into the application, but it is carried out by a SAP ECC transaction. So we assume that the master data have been already inserted. The first thing required to the users is to indicate the products involved in each campaign present in the system. This association is needed to assess the volume of products associated to each campaign, in order to evaluate its economic impact.

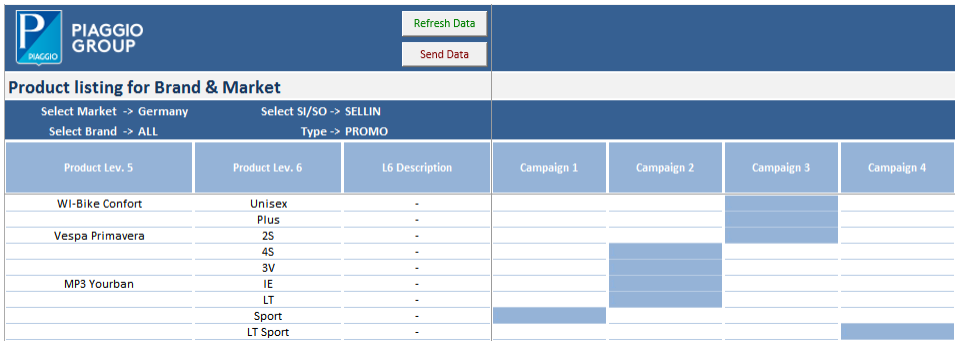

Figure 5.7. Input schedule for Product Listing

This activity is accomplished by means of a schedule called *product listing*. It allows, by activating filters, to consider just one market and specific types of campaign (eg. promo Sell-In). After refreshing data, the schedule build a matrix, whose rows are products level 6 of the hierarchy, and columns are campaigns. In the cell of incidence it is possible to indicate by flagging if that product is involved in that specific campaign. Until now, we have defined the associations between products and campaigns, but we have not configured campaigns yet. Let us see how parameterize Sell-In promo.

Promo Sell-In input schedule

Unlike previous schedules, now a table entry is a promotional campaign, instead of a product. In reference to Fig 5.8, the first column shows the campaign identifier. The second one shows the volumes of Sell-In impacted by such campaign, according to the matrix defined in phase of product listing. As defined in the requirements analysis, for each campaign the market controller expects to have to enter two parameters: *Volume Incidence* and discount percentage (*Promo Sell-In*). For this reason, there are two editable columns on this tab. Volume incidence is the percentage of volumes that actually are expected to be impacted. We recall that this kind of campaigns is essentially a reward for the dealers and take effect only upon reaching a certain sales volume. Therefore, not all dealers will be able to get the bonus provided by the campaign, but only a part of them which is

estimated by this index. When the percentage is applied, the effect is instantly visible on *Volumes In Promo*, in the fourth column. The system recovers the price information and applies it to volumes, showing the corresponding revenue net of basic discount in the fifth column (*Net Basic Discount*). With the insertion of the discount percentage, we are able to calculate the cost of the campaign. The latest three columns show respectively the *Unit Cost* of the campaign, the total cost on volumes (*Cost Promo*), and the *Net Sales*, namely the revenue reduced by the basic discount and the effect of the campaign at issue. These three values are easily derivable from the previous columns. We can observe that the logics formalized in the requirements analysis (Fig 3.5) is been followed.

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Refresh Sheet

Send Data

Setup sell-in promo campaigns

Select Market -> Germany

Select Brand -> ALL

	November							
Campaign	Volumes Sell-In	Incidence (%)	Volumes in Promo	Net Basic Discount	Promo Sell-In	Unit cost Promo	Cost Promo	Net Sales
Campaign Example	50	80%	40	1'500'000.00	2.00%	600.00	24'000.00	1'476'000.00
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•

Figure 5.8. Input schedule for Sell-In Promotional Campaigns

Promo Sell-Out input schedule

The input schedule for promo Sell-Out, shown in Fig 5.9, presents a very similar structure to that for promo Sell-In.

PIAGGIO GROUP

Refresh Sheet

Send Data

Setup sell-out promo campaigns

Select Market -> Germany

Select Brand -> ALL

Campaign	Volumes Sell-Out	Incidence (%)	Volumes in Promo	Net Basic Discount	Promo Sell-Out	Unit cost Promo	Cost Promo	Net Sales
Example Campaign	50	80%	40	100'000.00	4.00%	100.00	4'000.00	96'000.00
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•
•••••	•	•	•	•	•	•	•	•

Figure 5.9. Input schedule for Sell-Out Promotional Campaigns

It is worth to highligth that the calculation logic of promo Sell-Out effects

is slightly different. In fact, the user expects to parametrize the promo with an absolute *Unit Cost Promo*, instead of a discount percentage, that is derived consequently.

Bonus and Settlement input schedule

For the sake of completeness, we mention input schedules for configuring Bonus Campaigns and Settlement, shown respectively in Fig 5.10 and Fig 5.11. According to the requirements analysis, each campaign has a corrispondence 1:1 to a brand, and only a parameter needs to be defined, the percentage discount, with monthly granularity. Recall that Bonus is articulated in Sell-In and Sell-out, and the user selects the desired value through a filter.

PIAGGIO GROUP

Refresh Sheet

Send Data

Bonus - Sales Planning 12

Market -> UK

Type -> Sell-In

Camaign	October	November	December
Vespa	2.00%	2.50%	3.00%
Gilera	2.00%	2.50%	3.00%
Scarabeo	2.10%	2.50%	3.00%
Piaggio	2.10%	2.50%	3.00%
Aprilia	2.10%	2.50%	3.00%
Moto Guzzi	2.10%	2.00%	3.00%
Derby	2.10%	2.00%	3.00%

Figure 5.10. Input schedule for Bonus

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Refresh Sheet

Send Data

Setup settlement - Sales Planning 12

Market -> UK

Camaign	October	November	December
Vespa	2.00%	2.50%	3.00%
Gilera	2.00%	2.50%	3.00%
Scarabeo	2.10%	2.50%	3.00%
Piaggio	2.10%	2.50%	3.00%
Aprilia	2.10%	2.50%	3.00%
Moto Guzzi	2.10%	2.00%	3.00%
Derby	2.10%	2.00%	3.00%

Figure 5.11. Input schedule for Settlement

5.4 Deployment

Deployment is the convergence of technology, data, and applications on the business users' desks, along with the necessary education and user support structure. Data warehouse deployment needs the coordination of several variables and it requires an extensive planning. The project team should start preparing the actual deployment months before it is scheduled to occur.

The part of the process discussed in this chapter is the one that presents the greatest difficulties with respect to deployment, similarly to what happened for requirements analysis. The reason is this phase is carried out by several users in parallel, essentially one for each market in which Piaggio plays. This distribution of the process, if it is not properly managed, could create dispersion in the final phase of deployment, in terms of technology preparation, education and communication support. In this section, we see how Piaggio BI team has faced this step, following the guideline proposed in [Kim98].

Determine Desktop Installation Readiness. The technology that resides on the users' desktops is the last piece that must be put in place prior to deployment. Unfortunately, organizations often underestimate the effort and lead times required to implement the user-oriented components of their technical architecture. This responsibility in Piaggio is outside the BI Team, rather it is assigned to an outsourcing company. The line followed is that one to maximize the standardization and uniformity of technology adopted in order to have mostly common procedures and shared knowledge. In order to manage this criticity, the trend is that one to use tools which provide client browser-based, accessible by any desktop, in order to reduce the users' pc maintainance. This is the case of BO WEB Intelligence, a reporting tool that we will see in Chapter 7. When this approach is not possible, the alternative way is to adopt a Terminal Service (or Remote Desktop Services), so the users can access the applications needed by connecting to a remote desktop, that is mantained by a third part. This is the solution adopted for the installation of the client BPC.

Develop the End User Education Strategy. Business users' education must be well orchestrated. A robust education strategy for business users is a prerequisite for data warehouse success.

In this regard, the BI team has prepared a training session lasting three days, in which all the European market controllers (about 15 users) have been invited to attend. It was an opportunity to actively engage users and to create excitement around the project.

The first day was dedicated to the presentation and introduction to the project itself. There were recalled the steps of the process and the adopted

logical in them.

The second day was dedicated to the practice of the process step by step. Every market controllers, led by the BI project manager and supported by the BI team, filled all BPC input schedules in.

On the third day, we made a consolidated analysis of the input data with reporting tools that will be discussed in Chapter 7, in order to show effectively the benefits and potential introduced by the adoption of this application. Finally, we have devoted time for an exchange of views, useful to gather feedbacks and suggestions for future evolutions.

Develop an End User Support Strategy. Establishing support communication with users is fundamental for the project success. It is important to maintain an ongoing dialogue with the business users, consisting at least of general informational and status updates. Moreover, success stories can help to motivate the more timid or reluctant users.

Beside this attitude, it is suitable to provide a documentation. Bi applications are subject to rapid changes, thus elaborate and expensive formal documentations are about to become obsolete before they have been distributed. Documentation is nearly worthless if it is not kept up to date. According to [Kim98], we have produced light documentation materials with usage examples, mostly adopting a graphical approach based on slides.

Develop the Deployment Release Framework. The process used to deploy BI application is strikingly similar to the process used to deploy a new commercial software package. It is characterized by an alpha period, an iterative testing process performed by the internal team. Then we have a beta period, where a limited number of business users are given access to the application. This group is called beta team, and should be characterized by availability, motivation and flexibility. The beta team members should be well-respected by the user community.

Chapter 6

Data Model

In this chapter we want to describe the data model that supports the application, developed in Business Warehouse environment. The project involves the development of several multi-dimensional structures and flat ones (Object Data Store), interfaced by ETL flows and BPC logics. The model as a whole is the result of several months of designing and development by the team in collaboration with the outsourcing consultants. Giving an accurate description of the entire model falls outside the scope of this chapter. We will give an overview of the structures and the information flows to undestand how the data born and how it gets to be ready for reporting. The focus will be kept on the multidimensional model description of the Sales Planning Evaluation cube in Fig 6.1. This data mart is the core of the design, because it represents the final objective of the planning activity, and the starting point for business analysis.

6.1 Information flow

In this section we describe what are the information flows characterizing the data model. In other words we explain where the information borns, where the information arrives and the logical steps the information passes through. It is suitable to premise that we set the explanation to a certain level of abstraction, to not fall too much in technical descriptions. The focus will be maintained on the general understanding of the entire application.

At first, we can observe that information flow is little bit atypical. Usually, in fact, it happens the main data source is represented by a transactional system, which mantains events recorded daily by business process activities like sales, orders, customers behaviours and so on.

Unlike this scenario, in our case the biggest part of information is generated

by a complex planning process, exploiting suitable supporting tools like Business Planning and Consolidation, which allows interfacing directly the business user with multi-dimensional structures in datawarehouse environment.

An abstract representation of the model is given in Fig 6.1. In the bottom layer we have the transactional system ERP, in the middle the data warehouse environment, on the top layer user applications for planning and reporting.

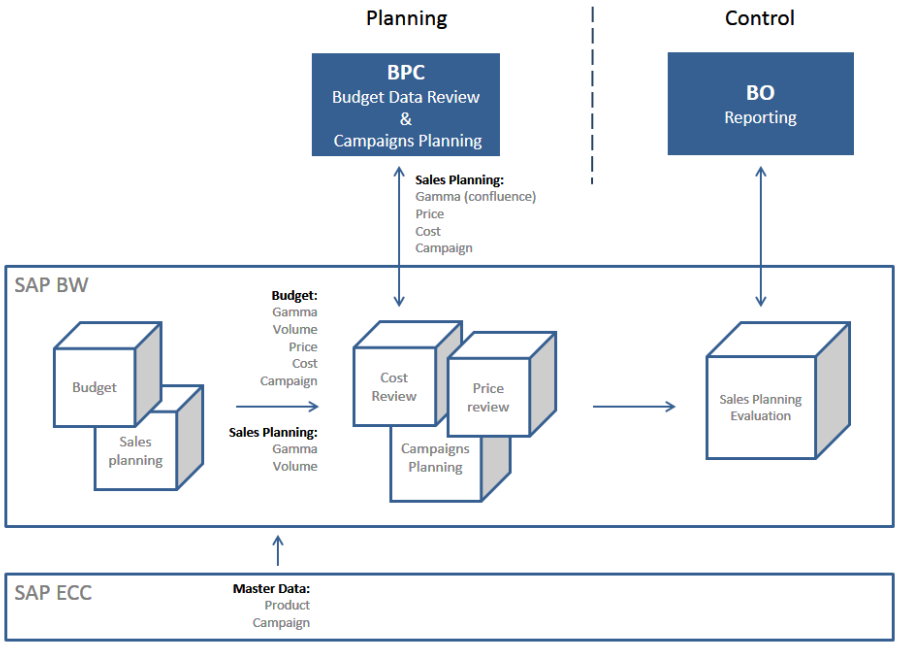


Figure 6.1. Information flow

In the BW layer, we can distinguish three main parts of the model:

- On the left, we have a set of pre-existing structures, for supporting similar projects to this one, such as budgeting and sales planning. This set of structures represents one of the data sources required to build our reference cube. In the budgeting cube are maintained information about products: volumes, prices and standard costs. Whereas, sales planning cube maintains information relating to sales volume at forecast.
- In the middle, we have a set of multi-dimensional structures that represent a staging area for all planning activities involved in the project: cost reviews, price review and campaigns planning. This set is supplied by 3 sides. Firstly,

by budgeting and sales planning cube mentioned above. Secondly, directly by the business user input through BPC. Finally, master data concerning products and campaigns are retrieved from the ERP system.

- On the right, we have a data mart for OLAP analysis and reporting. It is the final cube we have to supply by a suitable ETL flow, aimed to clean and adjust data collected in the previous steps, according to the multi-dimensional definition that we are going to describe in this chapter.

6.2 Multi-dimensional Model

We present an abstract multi-dimensional data model to well support the needs of the business users. We put the focus on the *fact*, its *measures*, its *dimensions*, *dimensional attributes* and *hierarchies*. Let us recall the two main business requirements in order to make an analysis-driven data mart conceptual design:

Profitability analysis: the analysis of the sales planning profittability in terms of revenue, standard costs, promotions costs, along dimensions of product, market and time.

Comparison analysis: the profittability analysis budget versus forecast.

6.2.1 Fact

The requirements analysis show that the facts are about sales planning evaluation segment, a set of quantities, mostly economic, related to forecast or budget sales of a products range, resulting from a complex planning process. With regard to the **granularity** of the fact, the data of interest are about each single product planned in a specific sales planning, a process occurring every month, or in a specific sales budgeting, a process occurring every year. In the first instance, we could say that, of a certain sales planning segment, we are interested in volumes, revenue, campaigns cost, standard cost, standard margin. Let us see in details the measures needed to satisfy the requirements.

6.2.2 Measures

Volumes Sell-in: the volume planned to be sold to the dealers;

Volumes Sell-out: the volume planned to be sold to the final consumer;

Gross Sales: the revenue related to the Volumes Sell-in;

Basic Discount: the cost due to contractual discount applied with dealers, based on loyalty to Piaggio's Brands;

Sales Net Basic Discount: the gross sales deducted by the basic discount;

Unit Sales Net Basic Discount: the unitary sales net basic discount;

Promo Sell-In: the economic impact of promo Sell-In campaigns on the sales planning segment;

Promo Sell-Out: the economic impact of the promo Sell-Out campaigns on sales planning segment;

Bonus Sell-In: the economic impact of the bonus Sell-In campaigns on sales planning segment;

Bonus Sell-Out: the economic impact of the bonus Sell-Out campaigns on sales planning segment;

Settlement: the economic impact of the settlement campaigns on the sales planning segment;

Total Discount: the total economic effect of the promotional campaigns on the sales planning segment;

Total Discount (%): the total economic effect of the promotional campaign as percentage of the sales net basic;

Net Sales: the sales net basic deducted by the entire effect of the promotional campaign (Total Discount);

Standard Cost: the cost that includes production cost and distribution costs for the sales volume Sell-In;

Unit Standard Cost: the unitary standard cost;

Standard Margin: the expected standard margin for the sales volume Sell-In, obtained deducting from the net sales, the standard cost;

Standard Margin (%): the expected standard margin for the sales volume Sell-In, as percentage of the sales net basic discount;

Unit Standard Margin: the unitary expected standard margin. If relating to different products, it is calculated as average weighted on volumes.

6.2.3 Dimensions

Dimensions put facts into context, and are used to analyze them. In general a dimension is described by a set of attributes used to qualify, categorize, or summarize facts in reports.

PRODUCT: this dimension allows to navigate the sales planning evaluated on a particular product or range of products. Furthermore the dimension is organized on a hierarchy that allows to drill down and roll up on different level of granularity of the product gamma.

Product hierarchy 1: the level concerns the most general product classification. Possible values are accessories, spare parts, vehicles. We are interested in the branch of vehicles and we will focus on it;

Product hierarchy 2: splits vehicles into motorcycle, scooter, bicycle, and commercial vehicles;

product hierarchy 3: splits each element of level 2 into displacement of the engine (50cc, 51-125cc, 126-300cc, etc.);

Product hierarchy 4: it is often said *product segment*, and it represents the last classification before falling into specific families. For example, this level splits motorcycles into naked, custom, turismo, or splits scooter into 2 wheel, 3 wheel, high wheel;

Product hierarchy 5: here starts the classification by family and appears the names as commonly known by the people: Vespa, Mp3, Scarabeo, Beverly, Liberty, California, Caponord, etc;

Product hierarchy 6: splits the family into specific models, for example it splits Vespa into Vespa Primavera, Vespa Sprint, Vespa Gts, Vespa Px, Vespa Lx, Vespa S, Vespa 946;

Product hierarchy 7: this level, called also "uncolored", adds extra information and optional, for example 2STROKE, 4STROKE, 2V, 4V, ABS;

Product description: an informal additional description of the product.

There would be also the level 8 existing that splits by colour, but is not involved in the planning, but only in the actual environment. It is interesting to observe that the brand does not appear in the hierarchy because it is a classification independent. The reason is that some specific cases of models are sold under different brand depending on the market.

ORGANIZATION: this dimension allows to segment the sales planning evaluated on different markets, different geographical areas and commercial responsibilities.

Market: this dimensional attribute represents a country where Piaggio Group is acting. Examples are Italy, Germany, Spain, France, UK, India, Vietnam and several minor market. Small countries usually are grouped into a unique market. Often this kind of market are not managed directly by the company, but instead by importers that essentially buy the vehicles and manage themselves the distribution, sales and marketing in those countries;

Market type: this dimensional attribute classifies the market by type. Markets for example can be served by "Commercial network" or by "Importers";

Geographic area: this is essentially a set of markets grouped by a geographic criteria;

ID Responsibility: this dimensional attribute is useful for organizational purpose. This code represents a couple market-brand. It could happen for example that, in a single market, the sales responsibility for Commercial vehicle is different from the responsibility of Vespa;

Brand: it splits responsibility into Piaggio, Vespa, Gilera, Derbi, Aprilia, Scarabeo, Moto Guzzi, Ape and Piaggio-Commercial Vehicles. Note that this is not a product classification, but an organizational classification. Just think that a specific product can be sold as Derbi in a particular market, and as Aprilia in others.

SALES PLANNING: this dimension can be used to distinguish which definition of sales planning considering.

Sales Planning ID: an identifier of a sales planning. It is useful to choose one of the monthly sales planning defined. This attribute must include a value to identify budget sales planning (better said sales budgeting). A model of this type aims to make uniform the information about budget and forecast to help their comparison. Information related to budget and forecast does not born homogeneous, just trivially to consider the different granularity level of planning that surely is coarser at budget. Standardizing this information requires an effort in terms of ETL flows, but makes comparable the two plans, in order to adequately respond to business requirements;

Channel: the distribution channel. For example we may have "corporate" for referring sales business to business, "retail" for referring sales to final customers;

Sales Planning version: usually market planner makes different working versions of the sales planning before reaching the final one. It is useful to compare different scenario of sales planning.

CAMPAIGNS PLANNING: this dimension can be used to distinguish which definition of promotional planning considering.

Campaigns Planning ID: an identifier of a campaigns planning. As for sales planning, it is useful to choose one of the monthly campaigns planning defined. In our specific case, this dimension must include a value to identify budget campaigns planning (often said marketing budgeting or campaigns budgeting). A model of this type aims to make uniform the information about budget and forecast to help their comparison in order to suitably respond to business requirements;

Version: usually market controller makes different working versions before reaching the final one. This attribute identifies the various working versions and it is useful to compare different scenario of promotional campaigns.

TIME: it allows to delimit time range with the possibility of drilling down till monthly grain.

Month-Year: the month;

Year: the year.

UNIT: it allows to analyze the sales planning evaluation on different currency to keep in consideration also eventual rate exchange effect on the results.

Currency: currency, as we will see, is a particular dimension pre-defined in SAP BW, useful to model currency conversion.

6.2.4 Dimensional hierarchies

For the purposes of the data analysis, an interesting aspect to model, in the presence of dimensional attributes, is a particular hierarchical relationship between their values. It is a many-to-one association between pairs of dimensional attributes. In the terminology of the relational data model, we call this association as a functional dependency between two attributes.

Hierarchy	Dipendences	Type
Product	Level 7 → Level 6 → Level 5 → Level 4 → Level 3 → Level 2 → Level 1	ragged
Organization	ID Responsibility → Market → Geographic Area	balanced
Organization	ID Responsibility → Brand	balanced
Time	Month-Year → Year	balanced

6.2.5 Measures additivity

Analyzing the additivity of measures, in the first instance we can observe there are no measures fully additive. This is due to the presence of dimensions as campaigns planning, sales planning and currency, for which it makes no sense doing aggregations. The campaigns planning dimension allows us to identify the campaigns planning document. To make an example consider two different versions of the campaigns planning for the month of March, one done in January and the other done in February. It is clear that does not makes sense summing the measures relating to these two different plannings, but it makes sense to make comparisons or trends. The same reasoning can be applied for the planning of sales volumes.

	Product	Campaigns Planning	Sales Planning	Organization	Unit (currency)	Time
Volumes sell-in	✓			✓		✓
Volumes sell-out	✓			✓		✓
Gross sales	✓			✓		✓
Basic discount	✓			✓		✓
Sales net basic discount	✓			✓		✓
Unit sales net basic discount						
Promo sell-in	✓			✓		✓
Promo sell-out	✓			✓		✓
Bonus sell-in	✓			✓		✓
Bonus sell-out	✓			✓		✓
Settlement	✓			✓		✓
Total discount	✓			✓		✓
Total discount (%)						
Net sales	✓			✓		✓
Standard cost	✓			✓		✓
Unit standard cost						
Standard margin	✓			✓		✓
Standard margin (%)						
Unit Standard margin						

Figure 6.2. Additivity analysis

Currency is a particular dimension pre-defined in SAP BW, which provides a basis for setting up complex information models, supporting for instance multiple languages and multiple currencies, with automated translations based on the same currency conversion rules as in SAP ECC. The currency conversions is provided by the OLAP engine. Once again, it does not make sense summing measures on different currencies, but it is useful making comparison for an exchange effect analysis.

Then we have measures not additive for any present dimension. In particular, we have unit sales net basic discount, unit cost standards, and unit standard margin which are unitary amount related to products. It does not make sense aggregate them by sum, but it makes sense, for example, average them to weighted volumes when considering a range of products.

Finally, we have the total discount (%) and standard margin (%) that are not additive by their rate nature.

6.2.6 Calculated Measures

The most critical measures, often to be avoided, are the non-additive because they can not be aggregated with the sum. Typical examples are measures defined as rates or percentages, like total discount (%) and standard margin (%) seen above. These measures must be broken down into underlying additive components, to calculate the ratio of the sums, not the sum of the ratio. These additive components are usually defined as measures that can be safely aggregated to any level of detail.

The non-additive measures should be computed in a **query**, or by additional processing logic in the **reporting tool**, for example the non-additive margin rate is computed as the ratio of the margin to revenue. In order to resolve this issue, the table below reports all the measures calculable starting from others. In bold are highlighted those ones non-additive, that become semi-additive over the same dimensions of their components.

Measure	**Formula**
Sales Net Basic Discount	$GrossSales - BasicDiscount$
Unit Sales Net Basic Discount	$SalesNetBasic/VolumesSI$
Total Discount	$BonusSI + BonusSO + PromoSI + PromoSO + Settlement$
Total Discount (%)	$TotalDiscount/SalesNetBasicDiscount$
Net Sales	$SalesNetBasicDiscount - TotalDiscount$
Standard Margin	$NetSales - StandardCost$
Standard Margin (%)	$StandardMargin/SalesNetBasicDiscount$
Unit Standard Margin	$StandardMargin/VolumeSI$

6.2.7 Conceptual Scheme

We present a graphical conceptual model for data warehouses based on a simplified version of the Dimensional Fact Model (DFM) proposed in [GR09]. The formalism enables the representation of facts, dimensions and dimensional hierarchies.

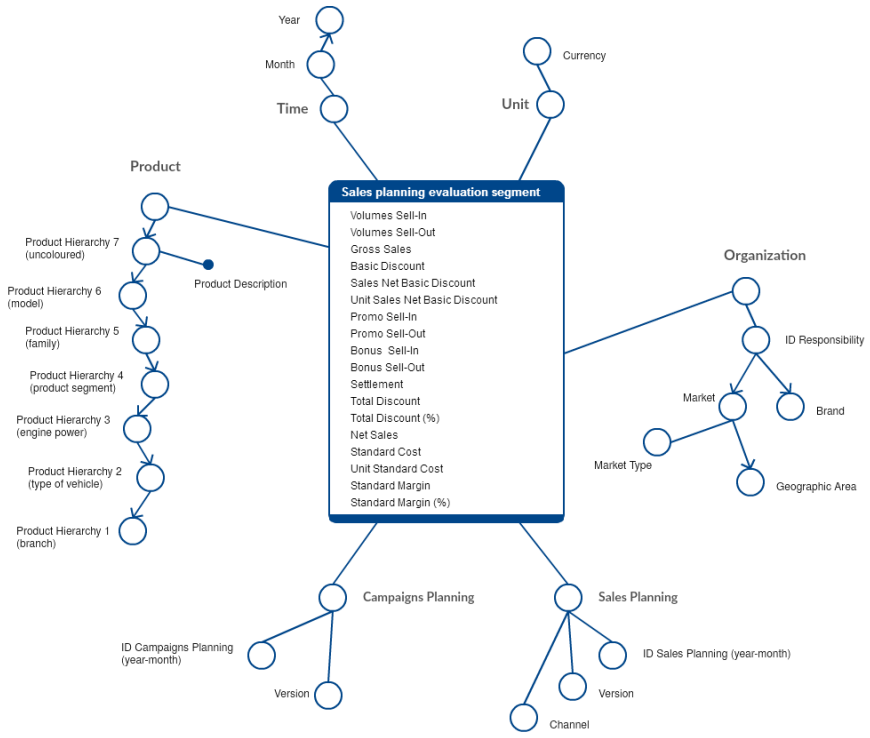


Figure 6.3. Conceptual star schema

Facts are represented through a rectangle separed in two parts: a first one containing the name of the fact, and the second containg the interesting measures concerning quantitative issues of the fact analysis. Dimensions are represented by outgoing edges from the rectangle of the facts that end with a circle, labeled with the name of the dimension. The dimensions typically contain the dimensional attributes, or attributes that characterize the taken dimension under consideration. There may be, it is not the case, also some dimensions, called *degenerate dimensions*, that do not contain dimensional attributes. Among the dimensional attributes there may be particular hierarchical relations between their values, said *dimensional hierarchies*. They are represented graphically as a Hasse diagram,

where each edge of the hierarchy models a functional dependency between two attributes. Moreover, descriptive attributes may exist, namely dimensional attributes or attributes of different facts from the measures that are not used to make groupings in the analysis. They are represented by arcs with circles lacking, an example in this schema is the product description.

6.2.8 Logical Scheme

SAP BW provides InfoCubes, which are the relational implementation of multidimensional data structures. The InfoCube data model basically is an extended star schema using surrogate keys for referencing dimensions (and through those also master data texts, attributes, and hierarchies).

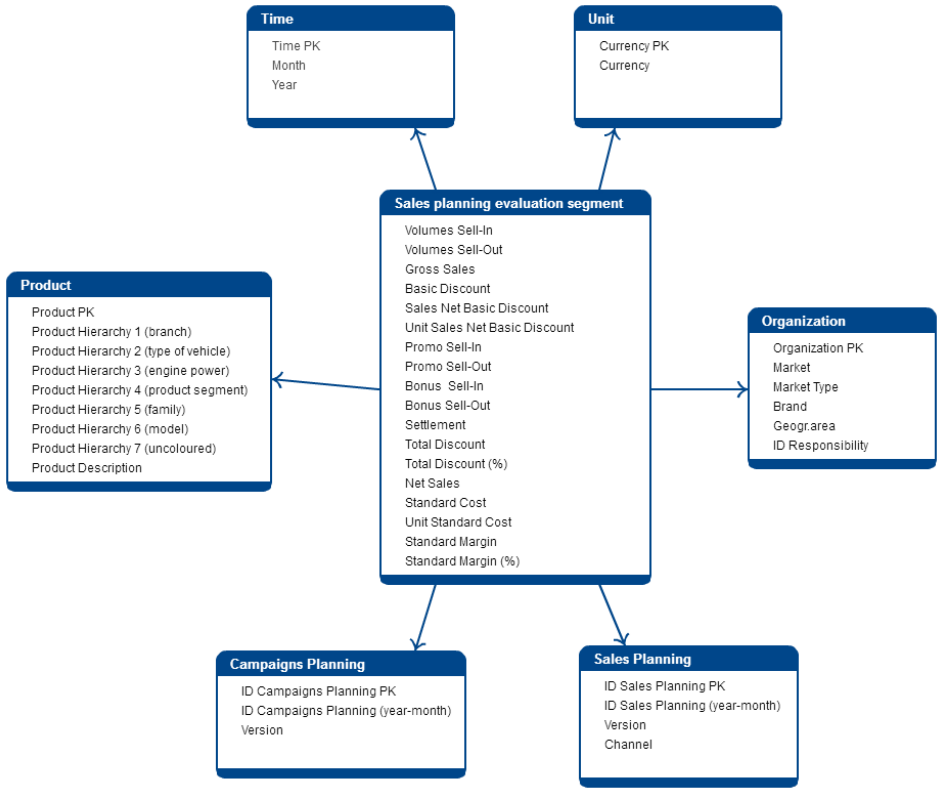


Figure 6.4. Logical star schema

Therefore, we can assume that the multi-dimensional model is implemented

with a ROLAP system and a conceptual multidimensional schema is transformed into a relational logical schema.

6.2.9 Fact Table Snapshot

To understand clearly the data model, let us show finally a full example of a fact row (Fig 6.5). On the left side is shown a record of the fact table, on the right side are shown all the record of dimensions referred.

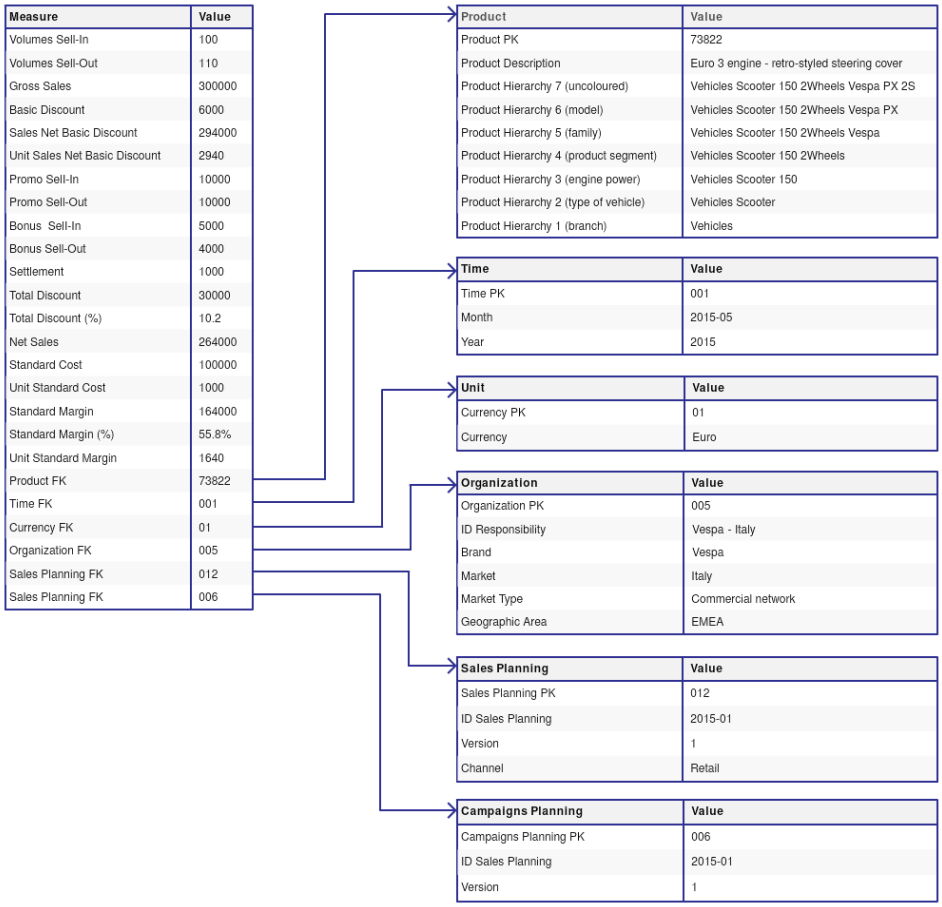


Figure 6.5. A fact row example

6.2.10 SAP implementation: InfoCube

InfoCubes are the relational SAP BW implementation of multidimensional data structures. Let us to clarify the SAP terminology used to describe InfoCubes, that risks to cause some confusion. What we called dimension is commonly referred by SAP as characteristic, whereas dimension is used by SAP to refer to a collection of characteristics. What we called measure is referred by SAP as key figure. Therefore, InfoCubes consist of *key figures* and *characteristics*, the latter being organized in dimensions. SAP BW organizes characteristics used in the InfoCube in up to 16 dimensions. Three of these dimensions are predefined by SAP: the time dimension, the unit dimension, and the data packet dimension.

The InfoCube data model basically is an extended star schema using surrogate keys for referencing dimensions and characteristics (and through those also master data texts, attributes, and hierarchies). As we will see in the Chapter 7, an InfoCube represents the basis for analysis and reporting processes in SAP BW.

Key figures and characteristics are called generally in SAP terminology InfoObjects, and they represent the core building blocks for all data warehouse-related meta data objects in SAP BW, InfoCubes included. InfoCube can be created through the Administrator Workbench for SAP BW (transaction RSA1), abbreviated as AWB, that actually is the main tool for tasks in the data warehousing process.

On the left side of the screen, there are various templates to start from. These give us a better overview of a specific task. The default setting is an empty template.

On the right side of the screen, we define the InfoCube. The approach consists of drag and drop to assign the InfoObjects in the Dimensions and the Key Figures folder. We can select several InfoObjects at the same time, and also transfer entire dimensions using drag and drop.

InfoCubes can also include *navigational attributes*, which are not physically stored in the InfoCube but instead in the master data attribute tables; they are available through characteristics defined in the InfoCube. Conceptually they are related to dimensional attributes discussed above in this chapter. For example the market type is a navigational attribute of the characteristic organization. From an end user's point of view, characteristics and navigational attributes are used in exactly the same way. However, accessing to navigational attributes is slightly less efficient than to characteristics stored in the InfoCube. The system assigns navigation attributes automatically. These navigation attributes can be flagged to analyze data in the Business Explorer.

A different type dimensional attribute is the *display attribute*, that is defined only for view utility in reporting, but not for aggregative purposes. An example in our schema is the product description, which is not phisically stored in the InfoCube, but rather in the product master data.

Giving a deep description about technical aspects of the implementation falls outside our purposes. For this issue refer to [PPS13]. For performance-relevant modeling aspects and indexing schema refer to [Sch06].

Chapter 7

Reporting

The primary function of the data warehouse is to support decision making, and so it must be specifically designed to answer business questions. Every day data are recorded, stored, and processed by information systems, but they give a little benefit unless they are transformed into useful information and knowledge. Data must be summarized into a more informative format in such a way that managers (or more in general knowledge workers, executives, managers, and analysts) can get the essence of the underlying data. In this Chapter we want to describe the way we attempt to satisfy the reporting needs of the sales manager, in particular: architectural aspects of reporting, technological possibilities, and front-end implementation of reports for profitability analysis.

7.1 Overview

In general, three categories of decision support can be provided:

Reports: it is the most basic and widely adopted decision support. It is suitable for managers who require static and institutional reports, mostly presented with the same layout. Reporting tools allow some elements of dynamism as filters or selection on the data. A reporting facility able to produce informative reports for managers timely is very important for the successful operation of any business. Piaggio makes extensive use of reports, the key tool for this kind of support is SAP BO (specifically Web Intelligence, which allows to access reports through any browser).

Multidimensional data analysis: it is usually referred with OLAP (OnLine Analytical Processing). It consists of observing a business fact distributed along different dimensions of analysis, usually accomplished interactively with

some kind of data analysis tool. The goal of data analysis is to get useful information from the data. Even this approach is quite common in Piaggio and the key tool is SAP BEx. It is preferred by managers who like exploring data without a prefixed rail, but with the possibility of observing data from different points of view.

Exploratory data analysis: it consists of extrapolating knowledge exploiting data mining algorithms and statistic-mathematical models. This data analysis technique is very different from reports and multidimensional analysis: user does not ask a particular question based on hypotheses, but rather he uses specific algorithms that analyze the data and report what they have discovered. This approach is currently the most uncommon and it is outside our discussion.

7.2 Reporting architecture

Once developed the data model in Business Warehouse environment, we want to realize reports and setting up analytics tools for business users. Among SAP Solutions there are a lot of possibilities that allow the achievement of those goals. Choosing one solution rather than another may depends on several reasons: special needs of users, common skills among staff, corporate culture or simply conventional standards of uniformity. In Piaggio, reporting and analytics tools most frequently adopted are Business Explorer (BEx) and BO Web Intelligence, that we discuss in the following of this chapter.

7.2.1 BEx Query

BEx is designed to attract a wide range of business users. Each multidimensional reporting and analytics activity is performed in SAP BW through a **query** definition stored in the Meta Data Repository. Queries provide access to multidimensional InfoProvider (e.g. InfoCubes), as well as flat information providers (e.g. ODSobjects, master data).

Business Explorer Query Designer is a standalone tool, more oriented to developers, that allows to define queries in an interactive environment by simply dragging and dropping the desired meta data objects into the query results area. This tool allows to define both tabular and multidimensional queries, that access powerful OLAP functions. A query essentially specifies a dynamic view on an InfoProvider used for multidimensional navigation. It can be seen as a SQL generator, that creates a simple list of records.

Note that only one InfoProvider may be assigned to a query. If more than one InfoProvider is needed, a MultiProvider has to be used. All characteristics, navigational attributes, and key figures available through an InfoProvider are available

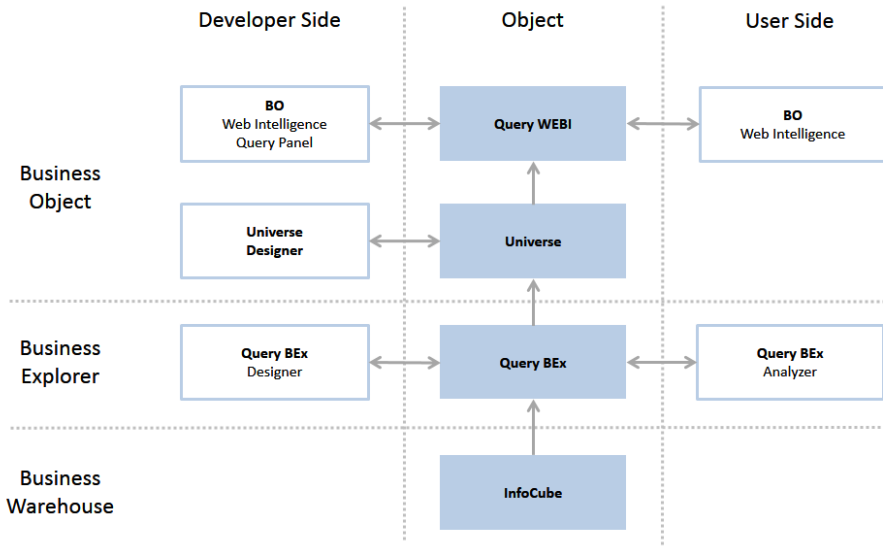


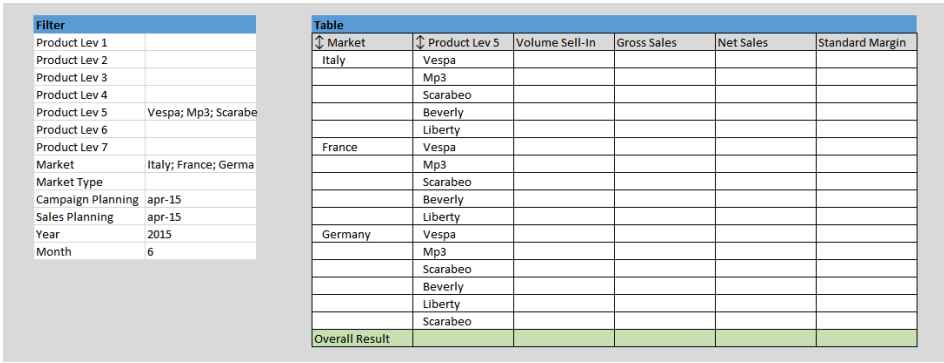
Figure 7.1. Reporting architecture

for use in query definitions. Since queries are multidimensional objects, they effectively define **subcubes** called query cubes on top of the InfoProvider. Query cubes define the degree of freedom available for query navigation in the presentation layer.

Once a query is defined, it can be opened in BEx Query Analyzer, an analytical and reporting tool implemented as an add-on to Microsoft Excel, that combines the power of SAP BW OLAP engine with the features (e.g. charting) of Microsoft Excel. An example is reported in Fig 7.2. On the left side we have characteristics which can be dragged on the table, in order to expand measures over them. Also we can define filters, by double clicking beside the characteristic itself. The field located in the intersection between measures and characteristics will be filled with the right values in real time.

7.2.2 Universe layer

A Business Objects Universe is the semantic layer that resides between an organization's database and the end user, but more importantly, it is a business representation of the data warehouse or transactional database. The universe is created using familiar business terminology to describe the business environment and allows the user to retrieve exactly the desired data. In other words, the role of a universe is to provide a user-friendly interface for non technical Web Intelligence



Filter

Product Lev 1	
Product Lev 2	
Product Lev 3	
Product Lev 4	
Product Lev 5	Vespa; Mp3; Scarabe
Product Lev 6	
Product Lev 7	
Market	Italy; France; Germa
Market Type	
Campaign Planning	apr-15
Sales Planning	apr-15
Year	2015
Month	6

Table

Market	Product Lev 5	Volume Sell-In	Gross Sales	Net Sales	Standard Margin
Italy	Vespa				
	Mp3				
	Scarabeo				
	Beverly				
	Liberty				
France	Vespa				
	Mp3				
	Scarabeo				
	Beverly				
	Liberty				
Germany	Vespa				
	Mp3				
	Scarabeo				
	Beverly				
	Liberty				
	Scarabeo				
Overall Result					

Figure 7.2. Example of query on Bex Analyzer

users to run queries against a database to create reports and perform data analysis.

A universe is a file that contains the following [1]:

- Connection parameters for one or more database middleware.
- SQL structures called *objects* that map to actual SQL structures in the database such as columns, tables, and database functions. The name of an object should be drawn from the business vocabulary of the targeted user group. In Designer, objects are qualified as one of three types: dimension, detail, or measure. Objects are logically grouped into *classes*. The name of a class should indicate the category of the objects that it contains. A class can be divided hierarchically into subclasses. Both objects and classes are visible to Web Intelligence users.
- A schema of the tables and joins used in the database. Objects are built from the database structures that you include in your schema. The schema is only available to Designer users. It is not visible to Web Intelligence and Desktop Intelligence users.

Web Intelligence users connect to a universe, and run queries against a database. They can do data analysis and create reports using the objects in a universe, without seeing, or having to know anything about, the underlying data structures in the database.

A universe is also a point of connection with other Olap Datasouces. For example, a universe can be created from Oracle OLAP cube structures, or from XML

[1] *Designer and universe fundamentals* in https://help.sap.com

files conforming to the following data source standards: Common Warehouse Model (CWM Relational 1.0), Common Warehouse Model OLAP (CWM OLAP), Oracle Warehouse Builder (Oracle WB), Data Integrator, IBM DB2 Data Warehouse Center (IBM DB2 DWC), IBM DB2 Cube Views.

Business Objects Universe Designer is a software tool that allows to create universes from Query BEx. For other datasources we would need another tool called Universe Builder.

7.2.3 Web Intelligence Query

In the top of the reporting architecture, we are finally able to create reports, but first we need to get data by querying the source data. Queries are built using the Web Intelligence Query Panel, an editor that allows to add and organise objects from a data source. This step may seem redundant because of that seen above in Query BEx Layer. Actually, it is a very similar step, but now, having defined universes, the objects that we choose for analysis are more suitable for business terminology. This makes simpler getting closer business users to this technology, and appealing users to make reports on their own and how they want.

There is the possibility to avoid the universe layer, in fact it is also possible to access directly SAP BEx Queries as a data source. SAP BW hierarchies are supported in the display as well as with regard to filter criteria selection. Moreover, other ways can be[2]:

- Personal data providers (such as Microsoft Excel or .csv files)
- Relational database queries via Free-Hand SQL statements
- Connection to the HANA (High-Performance Analytical Appliance) data source to use in-memory computing. HANA universes based on HANA views with variables are supported in Web Intelligence.

The query built through Web Intelligence Query Panel allows Business Objects server to transform business questions to SQL statements. The SQL query is then sent to the database to retrieve the data mapped to the objects you have selected. The information is returned to the Business Objects server as a subcube of data. This information is then formatted and displayed in a Web Intelligence report in multiple ways: tables (horizontal, vertical or form), crosstabs, charts (bar, line, area, pie or radar), and multiple block reports containing large amounts of data.

[2] *SAP BusinessObjects Web Intelligence Rich Client Users Guide* in https://help.sap.com

Queries based on universes can be hierarchical or non-hierarchical. Non-hierarchical queries organize data in dimensions which have no hierarchical relationship. Measures are common to all queries and return data, often numeric, calculated on the basis of the other objects in the query (dimensions or hierarchies).

In conclusion, **Web Intelligence** provides business users with reporting tools and interactive analytics on the Web, desktop, or mobile device. With a visual approach, it allows producing formatted reports and multidimensional data analysis in the web, and distributing results on the BI platform or exporting them into other formats such as PDF or MS-Excel.

7.2.4 Query Filtering

An important aspect to consider in order to meet business questions is filtering. Filters allow business users to reduce data and focus on their points of interest. Web Intelligence provides two kind of filtering: **Query Filter** and **Report Filter**.

Query Filters retrieve a subset of data from the database to the Web Intelligence document. For example, we could filter over the Product dimension to view only sales revenue for Vespa PX; or filter over the Market dimension to view only sales revenue related to Italy. Query filters allow to retrieve only the data we need to answer a specific business question, minimizing the quantity of data returned to the document, in order to optimize performance[3]. This performance improvement has the disadvantage to not allow dynamic analysis, because changing filtering values requires a new data retrieval and so increases the risk of time consuming. Query filter should be used to make selection valid for a long time in the analysis.

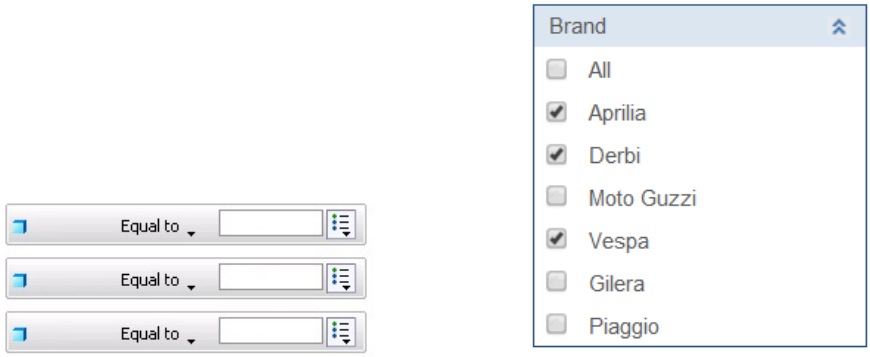
The alternative approach is called Report Filter, and it is useful to create a dynamic report depending on the user's selection in order to enhance the usability. Report filter does not actually restrict the data retrieved from the data source, rather it simply hide values at the report level.

Therefore, it limits the values displayed on reports, tables, charts, sections within the document. Changing filtering parameters does not imply a new data retrieval.

In Fig 7.3 are shown the two different types of filters as they appear to user side. The query filter appears as a prompt that allows to choose, over a specific dimension, the value by which instantiate a filtering condition. To create this type of filter there is a dedicated panel that allows to preset prompt as those shown, and additional conditions that may be combined with logical operators.

The report filter is more user-friendly than query filter, since they allow to improve usability. In fact, there are several GUI solutions to present filters to the user: check boxes, radio buttons, combo boxes, list boxes, etc.

[3] *Building queries with Web Intelligence Query* in https://help.sap.com



(a) Query filters: filter on data retrieval

(b) Report filters: filter on data visualization

Figure 7.3. How query filters and report filters appear to the user

The proper choice of the approaches shown above is critical to ensure a positive user experience during the analysis. In the following we will discuss our development choices and in particular how we adopted both approaches based on business needs.

7.3 Sales manager Front-End

The sales planning evaluation analysis and campaigns validation activities of the sales manager conclude the sales forecast process (Fig 7.4), or better they conclude a process iteration.

At this stage, we recall that the sales manager makes a corporate profitability analysis cross market and cross product, focusing on commercial area: effects of pricing policies and promotional campaigns. This analysis has the ultimate aim to assess the economic sustainability of promotional initiatives proposed by market controller, and eventually validate them by making them operationally feasible. Later in this chapter we show the reports as submitted in the first instance to the sales management area.

As we discussed in Chapter 3, the sales manager gave us provisions about type of information he needs and analysis he wants to do, but it is up to the BI team to interpret specifically some details, such as tools to be used, the layout and other implementation details. The report shown are intended as a BI team's proposal, which must be evaluated by managers and possibly improved by evolutions that usually characterize the lifecycle for this kind of applications.

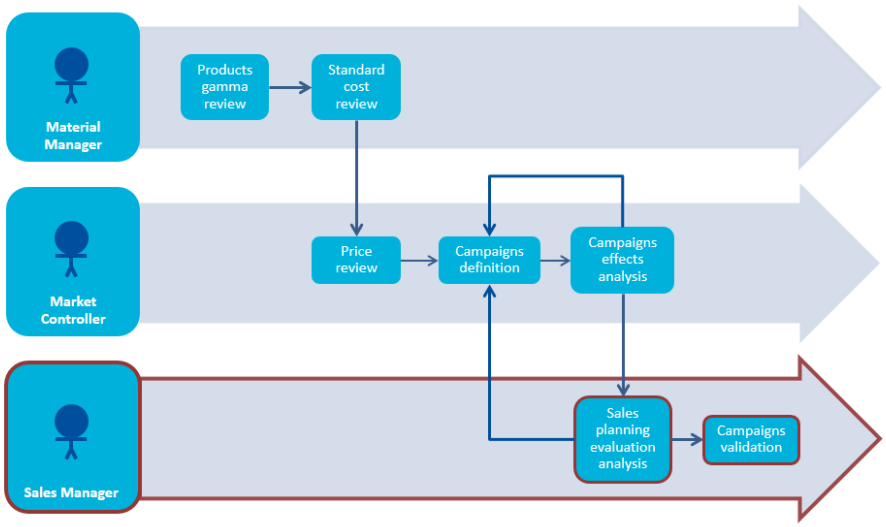


Figure 7.4. Business process for sales manager

Note that these tools will be also available to the market controllers, with restrictions on local data to their reference market, dictated by the mechanism of authorization checks.

7.4 Sales planning profitability analysis

In regard to the profitability analysis, with particular attention to the commercial area, we have chosen a layout which recalls that one of an income statement, in which each item is an economic amount, except for the first that represents a volume instead. There are also subtotals between the various items. Let us see it in details by referring Fig 7.5.

The first item shows the sales volumes of the sales planning segment we are considering. The second is the net basic discount. Note that gross sales is missing because, in the corporate culture, net basic discount is the reference starting price. After that, we have the impacts of each type of campaign and the sum of them: Promo Sell-In, Promo Sell-Out, Bonus Sell-In, Bonus Sell-Out, Settlement, and Total Discount. The total discount is also expressed as a percent value. Afterwards, we have the most interesting partial result for the commercial area, namely the net sales, which is the gross sales minus the cost of the promotional campaigns. Finally, there are the standard cost and the standard margin, the latter is expressed as both

absolute value and percent value.

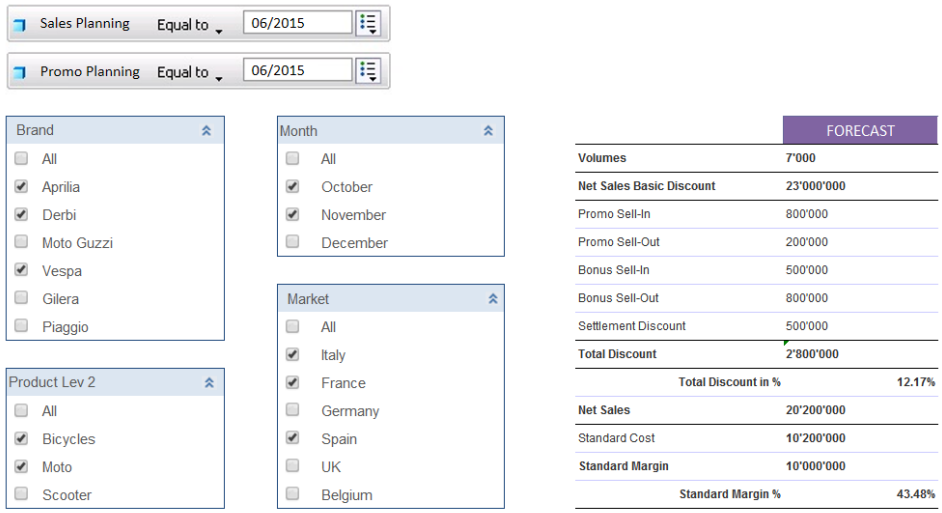


Figure 7.5. Example of report for sales planning evaluation analysis

In the report in Fig 7.5 have been used both filtering approaches: query filter and report filter. The query filters are aimed to select the sales planning and promotional campaigns planning from which retrieve information on sales volumes and campaigns effects. This choice reduces the data retrieved and improves the performance, but it removes the possibility to navigate easily over different sales plannings and campaigns planning, since selection changes would imply a new data load. However, until now, that kind of analisys is not required, so we provide other reports filters in order to meet the business requirements, that allow to navigate easily on dimensions as brand, product, month, and market. This filters are in checkboxes to enable the user to multiple choice. In fact, it can be interesting to consider, for example, measures related to market groups (e.g. Italy, France, and Germany) or brand groups.

The filters adopted in this report allow a general profitability analysis, but we must be ready to meet particular needs of managers if they were to arise. If the data model design is able to provide properly all the information needed by the business user, the project is sturdy, and possible changes in reporting or evolution are not burdensome. If the data model is not well designed and it is not ready to meet the perspective changes in the analysis required by the business user, we will need to take action also in the BW environment and, in this case, the changes developmental costs will be much more onerous.

Manager may want to move its focus on products, and to deepen the analysis on the highest level of the products hierarchy. In this case the data model supports us and we can implement a dedicated report filter as in Fig 7.6.

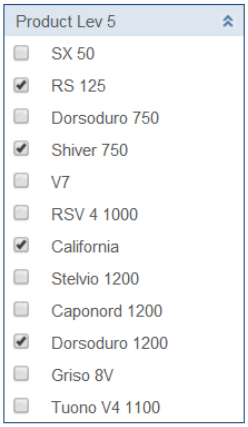


Figure 7.6. Example (not complete) of report filter for Product Level 5 Motorcycle

7.5 Profitability budget versus forecast

Let us see how we face the comparison analysis forecast versus budget, an important need expressed by the sales manager. The basic analysis can be done putting alongside the forecast values, their respective budget amounts, possibly showing the delta values. The result is shown in Fig 7.7. This is possible exploiting the dimensions Sales Planning and Campaigns Planning provided by our data model, where we have reserved identifier values for the sales budgeting and campaigns budgeting.

In the analysis we can think to focus on comparing different brands, or products themselves. One option is to expand the brand dimensions (or product), making it a bit more complex view, but satisfying a greater level of detail. Fig 7.8 reports an example, where the dimension Brand is expanded with Aprilia, Derbi, Moto Guzzi, Piaggio, and the sum of them. Each of these is splitted in forecast and budget as in the previous example. In order to simplify the view, a report filter is suitable to control the brands shown.

	FORECAST	BUDGET	DELTA
Volumes	**7'000**	**8'000**	**-1'000**
Net Sales Basic Discount	**23'000'000**	**25'000'000**	**-2'000'000**
Promo Sell-In	800'000	1'200'000	-400'000
Promo Sell-Out	200'000	300'000	-100'000
Bonus Sell-In	500'000	400'000	100'000
Bonus Sell-Out	800'000	600'000	200'000
Settlement Discount	500'000	400'000	100'000
Total Discount	**2'800'000**	**2'900'000**	**-100'000**
Total Discount in %	**12.17%**	**11.60%**	
Net Sales	**20'200'000**	**22'100'000**	**-1'900'000**
Standard Cost	**10'200'000**	**10'200'000**	**0**
Standard Margin	**10'000'000**	**11'900'000**	**10'000'000**
Standard Margin %	**43.48%**	**47.60%**	

Figure 7.7. Sales planning evaluation budget versus forecast

	October									
	2 Wheels Aprilia		2 Wheels Derbi		2 Wheels Moto Guzzi		2 Wheels Piaggio		TOTAL	
	FORECAST	BUDGET	FORECAST	BUDGET	FORECAST	BUDGET	FORECAST	BUDGET	FORECAST	BUDGET
Volumes	800	1'000	300	300	600	800	5'000	6'000	6'700	8'100
Net Sales Basic Discount	2'500'000	3'000'000	500'000	500'000	2'500'000	3'000'000	13'000'000	15'000'000	18'500'000	21'500'000
Promo Sell-In	90'000	100'000	10'000	10'000	50'000	100'000	300'000	400'000	500'000	600'000
Promo Sell-out	70'000	80'000	10'000	10'000	50'000	50'000	250'000	300'000	250'000	350'000
Bonus Sell In	60'000	70'000	10'000	10'000	50'000	50'000	250'000	300'000	250'000	350'000
Bonus Sell Out	20'000	30'000	10'000	10'000	50'000	50'000	250'000	250'000	500'000	500'000
Settlement Disc.	10'000	20'000	10'000	10'000	50'000	50'000	250'000	250'000	250'000	250'000
Total Discount	250'000	300'000	50'000	50'000	250'000	300'000	1'300'000	1'500'000	1'850'000	2'150'000
Total Discount in %	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Net Sales	2'250'000	2'700'000	450'000	450'000	2'250'000	2'700'000	11'700'000	13'500'000	16'650'000	19'350'000
Standard Cost	1'500'000	1'800'000	300'000	300'000	1'500'000	1'800'000	7'800'000	9'000'000	11'100'000	12'900'000
Standard Margin	750'000	900'000	150'000	150'000	750'000	900'000	3'900'000	4'500'000	5'550'000	6'450'000
Standard Margin %	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%

Figure 7.8. Sales planning evaluation budget versus forecast, separated by brand

7.5.1 A visual approach

Let us consider a visual analytics approach to provide business users with better and more effective ways to understand and analyse data. Fortunately our amount of data is limited and we do not need sophisticated visual tools, but we can have an interesting result by using simple ones.

Our proposal is a bubble chart, as reported in Fig 7.9. Each bubble represents a product. It is necessary keep control the number of shown products through a report filter, to avoid confusion due to too many colors adopted. Let us give a description of the properties of each bubble:

colour: it identifies the product. Mapping is done by a legend beside;

size: it identifies the forecast volume Sell-In of the product;

horizontal axis: it is the ratio of forecast margin to budget margin;

vertical axis: it is the ratio of forecast volume Sell-In to budget volume Sell-In.

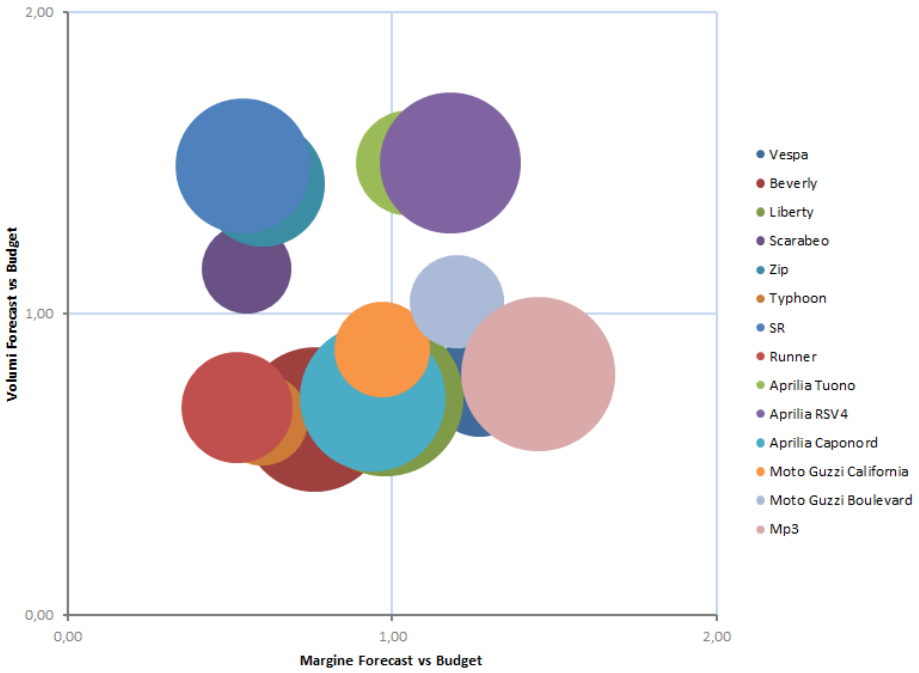


Figure 7.9. Bubble chart for products profitability budget versus forecast

If a product stays in the middle of the chart, both in the horizontal axis and in the vertical one, it means that product at forecast hits perfectly the target established at budget. If a product stays in the half plane below, it means that its forecast volumes have not reached the budget volume target, whereas, if it is in the half plane above its volumes exceed the target. Analogous reasoning for horizontal axis, products staying in the left half plan have a standard margin lower than how expected at budget, whereas those in the right half plan have the standard margin that exceeds the bugdet.

Quadrants interpretations

The chart can be conceptually divided into four quadrants, and each of them represents a different situation on the marginality of the product. A quadrant, in itself, does not represent a better or a worse situation than others, although apparently the top-right quadrant might seem idyllic, while the bottom-left critic. The graph should be a starting point for asking questions, to evaluate wisely.

A first consideration, that goes beyond the specific quadrants, is that the distance from the center of the graph is the first symptom of an anomalous situation. The farther away from the center, in any direction, as the forecast needed results are far from those defined in the budget.

Top-Left: budget objectives are not fully achieved, in fact target volumes are actually reached or exceeded, but this is not true for the standard margin. We must wonder if the promotional initiatives have been too aggressive, pushing sales, but eroding the margin too much.

Top-Right: apparently the ideal situation, where both volumes and standard margin have been exceeding the expectation. It is worth asking if the budget target was placed properly and market potential has been evaluated well in phase of budgeting.

Bottom-Left: apparently the most critical situation. Neither volumes nor standard margin have reached the budget target. Really, if the offset in this quadrant is mild, it could be a very positive situation, in which budget targets were placed well, and results are going to be very close to them. The budget reference must be interpreted as finishing line not easy to cross.

Bottom-Right: specular to the Top-Left situation. Standard margin is actually reached or exceeded, but this is not true for the sales volumes. If the offset is significant, it is worth asking if some promotional initiatives more should have taken place.

Conclusions

In this thesis we have discussed a project carried out in the period from June 2015 to January 2016 in Piaggio Group company. This thesis is aimed to describe the lifecycle of a Business Intelligence application for enhancing the sales forecast process in Piaggio Group.

First of all, we have seen the reasons that lead Piaggio to fund this project and in genereal many others on the same trail. Taking a look at the macroeconomic context in which the company is playing, and at the strategic declarations available in the income statements of the latest years, has helped us to find an answer. The global financial crisis started in 2007-08 has had a big impact on many market sectors, automotive included. In such a context, the strategic lines of Piaggio are oriented to an expansion to the Asian market where the company is playing very succesfully, and to improve the operating efficiency of all the company processes. From a business review it came to light the need of improving the sales forecast process, and the Business Intelligence has proved to be an important resource to pursue it.

BI team activities pass over the entire lifecycle of the application, from the requirements analysis, through the application design, implementation, testing, and deployment. Technical aspects and implementation are mostly cared by an outsourcing company. Our discussion reflects this modus operandi, and it focuses on functional and software engineering aspects.

We have talked about the sales forecast process in Piaggio, and we have analyzed the various steps from a functional point of view, highlithing the weakness that have driven the conceiving of this project. Sales forecasting is a complex process that involves several departments of the company. It is executed month by month, with the aim to draw out the expected monthly results in terms of sales volumes and economic amounts (revenue, cost, margin, etc). Improving sales forecast means to formalize, automate, integrate the process in the information system, and enrich the corporate information assets for the profitability analysis.

The initial phase of requirements gathering has shown some critical issues due to the high number of business users sharing part of the process. In fact, the steps related to the planning of pricing policies and promotional campaigns are

performed in a distributed way on the various country where Piaggio is playing. In such a case, we have seen that an approach based on interviews-only may be weak and dispersive, hence an alternative approach is necessary. As suggested by Kimball, it is the case of facilitated sessions, that consist of scheduling larger group sessions led by a facilitator, in our case the BI project manager. Facilitated sessions can be used to encourage creative brainstorming with a limited number of participants. They have been proved essential to share and validate with the business users several logics, necessary to proceed with the application design.

An anologous problem is related to the phase of deployment, where a suitable education of the business users is crucial for the success of the project. If allowed by the organisational structure, a training session attended by the business users can be very helpful. In addition, a light documentation based on slides can be more effective and easy to mantain than a formal and verbose one.

The phase of application designing has drawn out three main components: operational support for planning pricing policies and marketing initiatives, a data model suitable to hold the collected data and make them suitable for reporting, and finally a reporting platform to evaluate from different perspectives the results of this planning. All the project has been developed adopting SAP solutions, and a space of this dissertation is dedicated to the architecture and technological aspects.

A relevant added value is the full process integration in the information system. In front of a loss of flexibility in the procedures experienced by operators, we benefit at consolidated level of homogeneous, comparable and aggregated data, without the risk of leakage as naive planning approaches based on spreadsheets, and reducing risk of human errors.

Moreover, the information assets gained represents a basis for a more reliable, flexible and detailed reporting. To give an example concerning the profitability analysis, now it is possible to observe the economic impact that a certain type of promotional campaign will have on the profitability of the Vespa PX in the Italian market. It is clearly a very high level of detail, that would be not easy to achieve without this project integration, regardless the possibility of switching and combining in few seconds the same analysis with other products, markets, and dimensions discussed in Chapter 6.

Searching this level of detail in the understanding of business spending is a point to think about, that expresses the company's will to optimize business processes. The application is in the production environment since January 2016, and it is currently used by all the European market controllers (about 15 users) and the commercial management.

This stage is a finish line, but at the same time a starting point for evolution and new projects. A relevant hypothesis emerged among business users during the training session is to integrate actual results in the application, in order to be able to compare the forecast figures with the actual ones, similarly to what just done between forecast and budget.

This comparison is currently done at a coarser level of detail and not suitably integrated in the information system. It would be an onerous project, because actual results are of course not obtained from a planning process, but by a complex and independent calculation process. Thus, we would have critical issues in the logic definitions by which transforming actual results in order to be comparable with forecast results. The project would certainly have a significant impact on organizational and procedural aspects of the company.

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